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How a Railroad Shop Manufactures

A Hundred Connecting Rods Each Month

By Frank W. Curtis
Western Editor, *American Machinist*

NOT many railroad shops are equipped to manufacture one hundred connecting rods a month in addition to the handling of the average repair work. The Sedalia shops of the Missouri Pacific R.R. Co. are accomplishing this production, however, to meet a standardization program that calls for the application of an improved form of rod on all the 1,250 locomotives now in service.

After determining through many tests the most suitable types of rods and the material from which they should be made, the company investigated the available facilities for handling the proposed work. The result showed that new equipment would be necessary to fulfill the expected requirements. Machines were installed that now are efficiently producing a hundred rods per month.

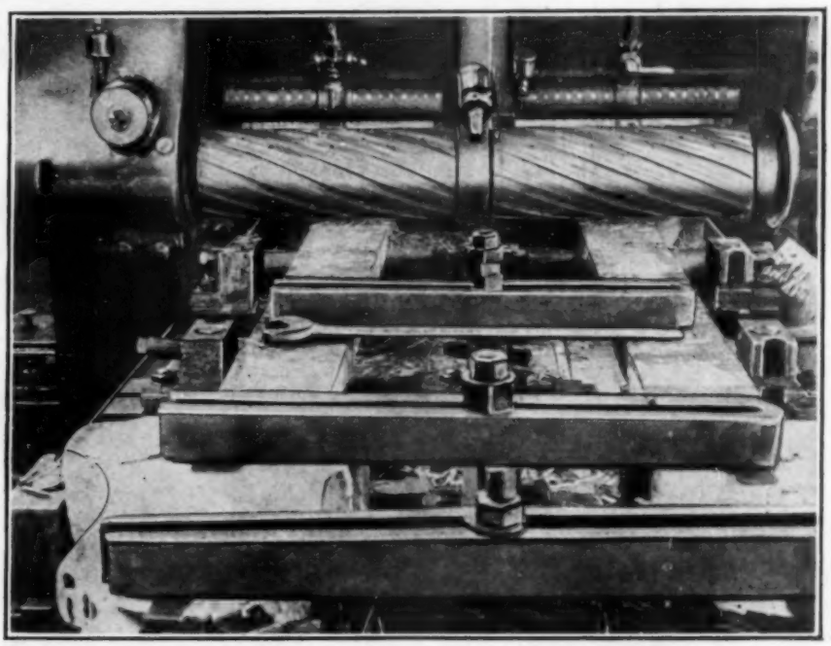
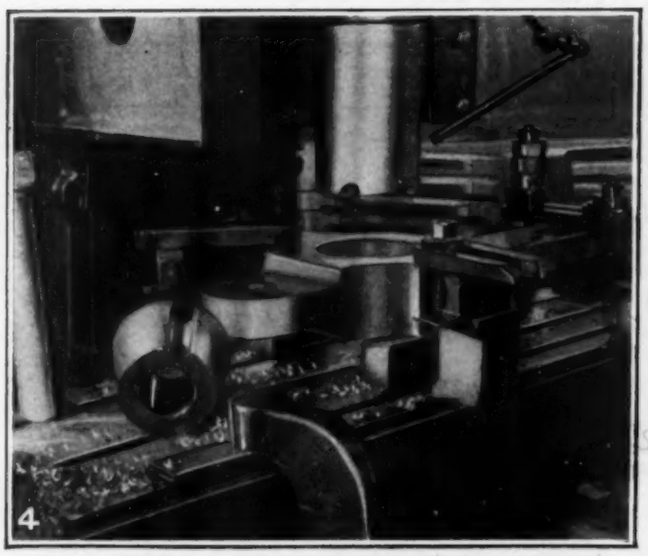


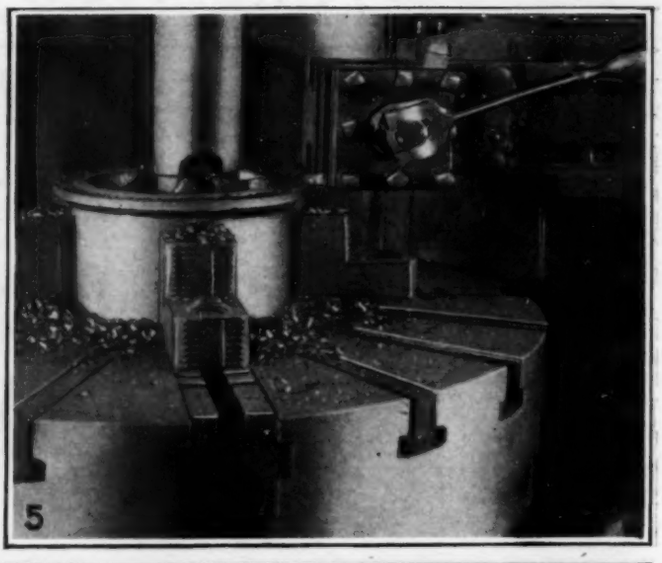
Fig. 1—Slab milling a pair of intermediate rods

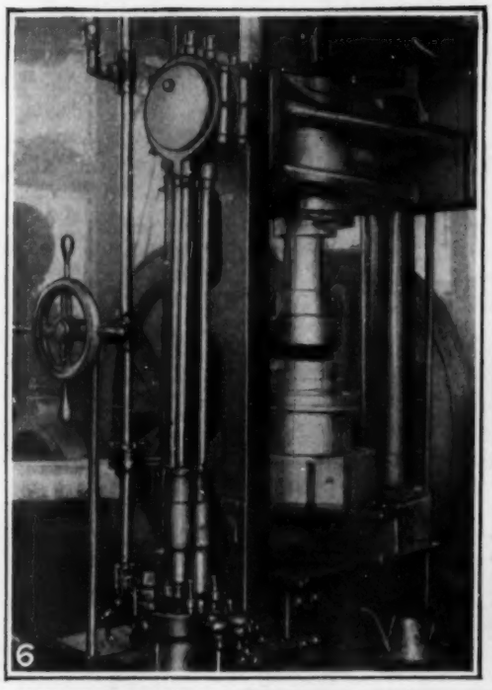
The connecting rods are of the solid-end type, equipped with floating bushings. All rods now in use that have been repaired by welding, and all rods with a thickness of metal around the hole below a given size, are being replaced as soon as the engines on which they are mounted can be shopped. The new rods are made of an alloy steel having an analysis of 0.45 to 0.55 carbon, 0.7 to 0.8 manganese and 0.15 vanadium. Billets of suitable shape for the various sizes of rods are ordered in large quantities to insure a sufficient supply on hand at all times.

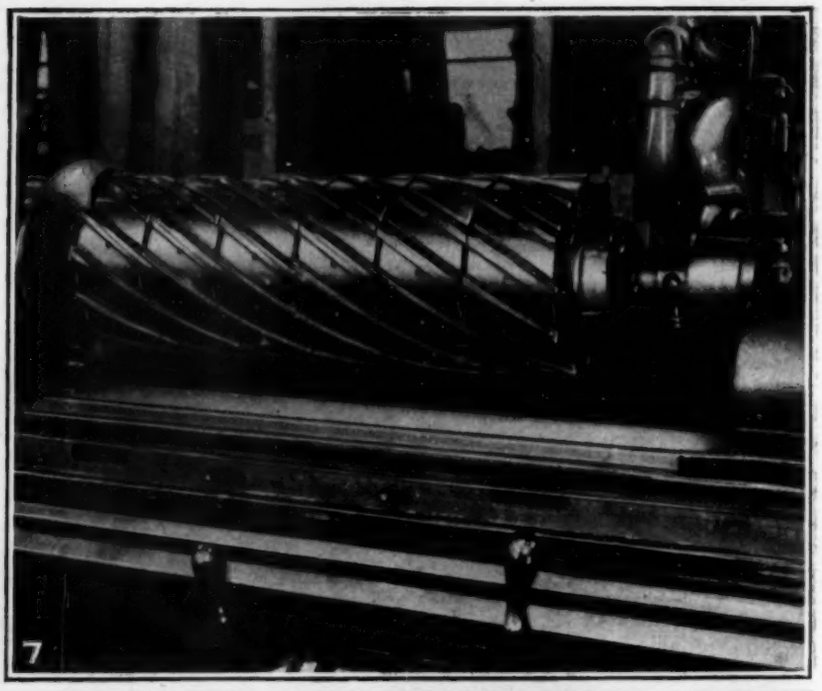
Forging is handled in two steam hammers of 3,500- and 5,000-lb. capacities. Gages and templets are used to check the dimensions. Upon completion of the forging operation, the rod requires annealing before it can be machined. The annealing furnace, located in the yard between the forge and the machine shops, has a capacity of 9 to 18 forgings, according to their size. The rods are loaded on a car that is wheeled directly into the furnace, the platform of the car acting as the floor of the furnace. Pyrometer control, that checks the heat at eight points of the heating chamber, is provided. After the furnace is loaded, the heat is brought up gradually to 1,650 deg. F., where it is held for 12 hr., and then allowed to drop to 500 deg. F. over a period of from 8 to 10 hr. The heat then is raised to 1,150 deg. F., held at that point for 10 hr., and then allowed to drop for 10 to 12 hr. until the temperature is below 500 deg. F. The rod is then in condition to be machined.

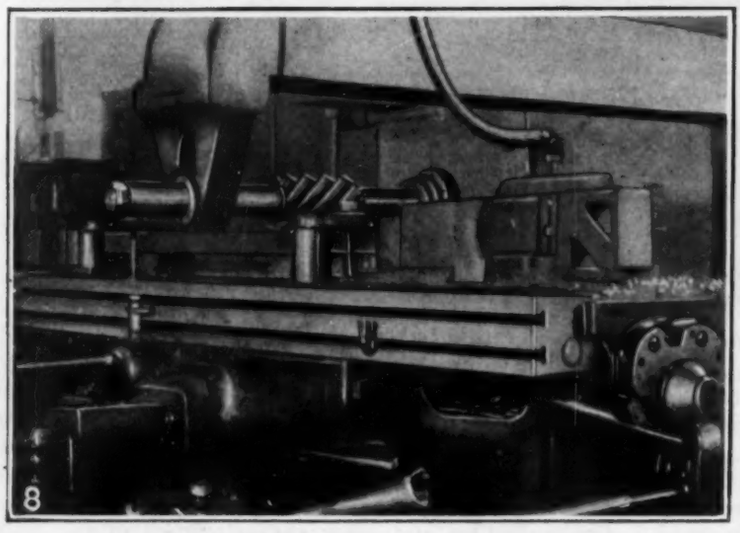
An identification mark is stamped on all rods before they are machined. A record of each rod is maintained to show the type of material it is made of and details of the heat-treatment. The mark is restamped in the machine shop as soon as the original mark has been removed. The marks are used in checking the date of manufacture and other characteristics of the rods in the event a breakdown should occur.











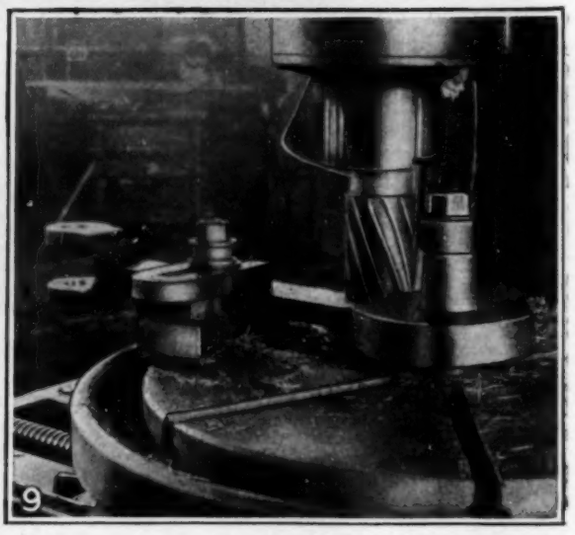


Fig. 4—Boring out end of rod. Fig. 5—Method of turning bushing. Fig. 6—Pressing bushing into rod. Fig. 7—Grinding a slab-milling cutter. Fig. 8—Slab milling back section of main rod. Fig. 9—Milling radius on small rod

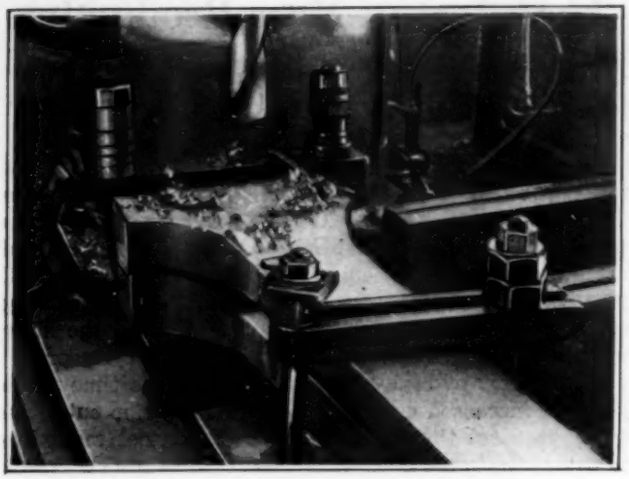


Fig. 2—Drilling locating hole in end of rod

The first machining operation after the rods have been layed out is the slab milling of the ends and center section of an Ingersoll milling machine as shown in Fig. 1. The several styles of rods are run through in lots of twelve or more. The work illustrated is the intermediate rod in which a pair is milled at one setting. The rods are placed in the fixture according to the layout marks, after which they are fastened in place by four heavy U-clamps as shown. As the cutters proceed along the work the clamps are removed one at a time and then replaced after the rods have passed to the rear of the cutters.

Two inserted-blade, spiral, slab-milling cutters, 10 in. in diameter and 24 in. in length, are used. The ends of the rods require the removal of ½ to ⅝ in. of metal that is taken off in two cuts, the first of which removes all but $\frac{1}{16}$ in. The cutters then are lowered for machining the central portion of the rods that requires the removal of ¼ to ⅜ in. of metal. Only one cut is taken on this part of the rod. The cutters operate at 17 r.p.m. and 3-in. feed per min. for all the cuts. After one side has been machined the work is turned over, located on parallels and machined on the opposite side in the same manner. An air-operated hoist is used for loading and unloading. The approximate total time for handling six sets of rods is 24 hr. To form a comparison of time, it requires 7 hr. to machine the first pair of rods, including the set-up time.

The rods are handled in pairs for the next operation, drilling a 2½-in. hole through both ends. The 6-ft. American triple-purpose, radial drill shown in Fig. 2 is used for the operation. The work is rested on parallels and is clamped to the machine table by two U-clamps. The hole location is laid out on the face of the top rod, after which a 2½-in. hole is drilled through both rods without the use of a guide hole. The drill is operated at 60 ft. per min. and 0.012-in. feed per revolution. A soda-water compound is used as a cutting lubricant.

The rods are fitted with a 2½-in. mandrel at both ends and handled in pairs for the milling of the radius on the ends as shown in Fig. 3. The machine is an Ingersoll vertical miller equipped with a swinging boom, built integral with the upright frame, that is used for lifting the work. Clamping is accomplished by a 2½-in. locating plug at the end of the rod to be machined and by a U-clamp placed over the central portion as shown. A 5x12-in. spiral milling cutter is used. Two cuts are required to complete the operation. On the roughing cut approximately ½ in. of material is removed, the cutter operating at 33 r.p.m. and the feed being 1 in. per min. On the finishing cut ⅛ in. of metal is removed, the cutter operates at 33 r.p.m. and the feed is 2⅝ in. per min. A soda-water cutting compound is used.

The rods then are edged on the Ingersoll machine shown in Fig. 1. Six rods are handled at one setting. A mandrel is placed through the 2½-in. hole so the projecting ends rest on parallels. The work is arranged on the machine table in two sets of three rods, held by U-clamps and end stops. The machine also is used to channel main rods 3½ in. in width and $1\frac{5}{16}$ in. in depth, the web section of which is held to ⅜ in. in thickness. The machine is operated 24 hr. of the day.

The large hole in the end of the rod is bored out on a Baker drill, shown in Fig. 4, requiring the use of a trepanning tool of special design. The tool is comprised of a guide pilot that fits into the center hole of the rod and an outside shell in which are mounted five ½-in. square cutting tools. The tools cut a 6-in. core out of the rod as they are fed through. To accommodate chip clearance a 1½-in. hole is drilled through the rod in line with the path of the cutting tools. The hole may be seen in the portion of the rod that has been removed, which lies to the left of the machine spindle. The machine is operated at 11 r.p.m. and 0.006-in. feed per revolution, and the depth of the cut taken is 4 in. The boring bar equipped with a ⅜-in. tool, shown standing next to the removed core, is used for sizing the hole to 7 in. in diameter. Soda-water lubricant also is used for the operation.

A trepanning tool of similar design is used for machining the 10-in. diameter holes of main rods. The boring bar for this size of hole has four cutters and resembles the usual style of boring head employed.

Fig. 3—Milling radius on side rods

All bushings used in connection with the rods are made on the 34-in. Bullard vertical turret lathe shown in Fig. 5. Both cast-iron and brass bushings are required. The castings are turned and faced on one side after which they are reversed for the boring and turning and the facing of the flange ends. The work illustrated is a cast-iron main-rod bushing, 10 in. in diameter, 8½-in. bore, 6 in. in depth and provided with a ¾-in. flange. Roughing cuts are taken at 16 r.p.m. and finish cuts at 23 r.p.m. The work is completed in 40 min., floor to floor time.

Pressing In the Bushings

Bushings are pressed in the rods on the Niles-Bement-Pond hydraulic press shown in Fig. 6. The work is leveled in the press by elevating the projecting end of the rod to a suitable height by a chain block. Both the bushing and the rod are coated with oil on their contacting surfaces before they are assembled. The machine has a capacity of 100 tons, although the pressure used is only between 20 and 25 tons. An allowance of $\frac{1}{64}$ in. on the diameter of the bushing is made for the press fit.

The Cincinnati grinder shown in Fig. 7 has been installed for the exclusive use of grinding milling cutters used in producing rods, including the slabbing, vertical and channeling operations. The 9-in. slab cutter shown on the machine is comprised of six sections totaling a length of 24 in. The abrasive wheel used is 14 in. in diameter and 1 in. in width. All cutters are ground wet. The front splash guard was removed for the photographing of the machine.

In addition to the production methods that have been described for the handling of the larger type rods, there are shown some of the operations required for machining the smaller rods. A similar procedure is followed although smaller machines are used. The requirement for these parts is not as large as it is for the larger rods yet the work that is scheduled is handled in an equally efficient manner.

Slabbing and Edging

Two No. 5 Cincinnati horizontal milling machines are used for slabbing and edging purposes. Fig. 8 shows the back section of a main rod being slabbed with a 4x8-in. helical milling cutter. Cutters up to 12 in. in length are used for machining the wider ends of the work. The roughing cutter is operated at 48 r.p.m. and 2½-in. feed per min., and the finish at the same speed but with a 3⅝-in. feed per min. The roughing cut removes from ¼ to ⅜ in. of metal leaving $\frac{1}{16}$ to $\frac{3}{32}$ in. for the finish. The rod is finished on both sides in approximately 4 hr. Edging of both sides is completed in 2 hr. The machine also is used for link-motion work and similar parts.

The Newton vertical milling machine shown in Fig. 9 is used for machining radii on the ends of rods such as shown in the preceding illustration. The work is held to the machine table by a plug in the center hole while the projecting end is secured by a U-clamp as shown. A 4x6-in. spiral milling cutter of the solid type is used. The cutter is operated at 60 ft. speed and 4-in. feed per minute.

A similar installation for producing approximately the same number of connecting rods is in operation at the Little Rock Ark., shops of this railroad.

The Effect of Mass Production on Machine Tool Design

By Arthur C. Pletz
The Morris Machine Tool Co., Cincinnati, Ohio

The automobile industry presents a fine example of mass production. The growth of the system was gradual. From 1900 to 1905, 1- and 2-cylinder cars were made in small quantities by means of standard machine tools such as engine lathes, turret lathes, drill presses, milling machines, and planers. Single cutting tools of carbon steel were used entirely, and the lathe was called on to handle such jobs as boring cylinders.

The advent of high-speed steel about this time made possible increased cutting speeds and heavier cuts. In order to meet these conditions machine-tool manufacturers re-designed their equipment: parts and bearings were made heavier, steel gearing was substituted for cast-iron, belt feeds were changed to gear feeds, and in some cases speed change boxes were offered. Multiple tooling on turret lathes was also tried with success.

Between 1905 and 1910, 4-cylinder cars became popular. The Ford Motor Co. cast the cylinders in one block and developed a machine to bore them at one time. Multiple-spindle drills also came into use. A demand for special purpose tools arose, but the machine-tool manufacturer did not feel justified to meet it. During the following five years many refinements were made including mostly automatic features, and some of the automobile manufacturers developed a few single-purpose machines. The Ford Motor Co. in conjunction with the Bullard Machine Tool Co. developed the "Mult-au-matic," which was a big step in the direction of high production tools.

From 1915 to 1920 with the impetus of war-time demand, the machine-tool industry was largely on a mass-production basis itself and prosperity was at its height. Machine tools were put to severe tests out of which considerable design data was obtained, but because the demand was so high, few changes in design were made in this period.

During the slump of 1921, the presence of large stocks of tools in warehouses necessitated the complete redesign of all lines in order to make this war-time stock obsolete and new tools salable. The machines had to be made more productive, more foolproof, and easier to operate. Hence from that time to the present, marked changes in design took place not only in standard tools but also in automatic machines capable of high production. Here again the influence of the automobile industry was felt in that alloy steels, heretofore used by that industry chiefly, now came into general use in machine tools. The design weaknesses that showed up during the severe war-production period were overcome by the use of heat-treated alloy steels.

Lubrication is another element in modern tool design that has been given careful consideration with the result that the life of the machines has been increased. Ball and roller bearings are also being adopted, and in a few cases hardened gears with ground teeth are being used. As a result of these refinements it is not surprising to find that prices are on the upward trend and are not inclined to return to pre-war levels.

Abstract of a paper presented at a meeting of the Cincinnati Section, American Society of Mechanical Engineers, May 27, 1926.

Machine Design and the Handling Problem

By Prof. Frank L. Eidmann
School of Engineering, Princeton University

Heavy machines make difficult handling jobs—The designer can provide means of handling the castings and moving the finished machine—Proper and improper base designs

RECENT studies of the cost of handling material in factories have shown that it is not unusual for handling charges to run as high as thirty per cent of the payroll. While the designer's influence on the cost of production has become generally recognized, there are still not enough engineers who study their design from the viewpoint of the problems involved in handling the finished product by modern methods of mechanical handling.

The designer of a machine may greatly influence the facility with which it may be handled from operation to operation during production, as well as after its completion. In designing a machine of which the component parts are heavy, the designer should keep in mind the handling of these parts from operation to operation in the plant. The various possible methods of handling the finished machine in the factory should be studied, and also how the machine may be loaded into cars for shipment, and how the unloading and handling of the machine by the customer may be facilitated.

In Fig. 1 is shown how lugs are provided on the frame of an electric motor, so that the finished motor may be handled conveniently by an electric truck or by an overhead crane. Transformers and large electric motors are also frequently provided with a heavy steel eyebolt at the top, for handling by crane. In Fig. 3 is illustrated a 70,000-hp. hydraulic turbine, each segment of the casting being provided with lugs which are cast on the frame to facilitate the handling by overhead cranes.

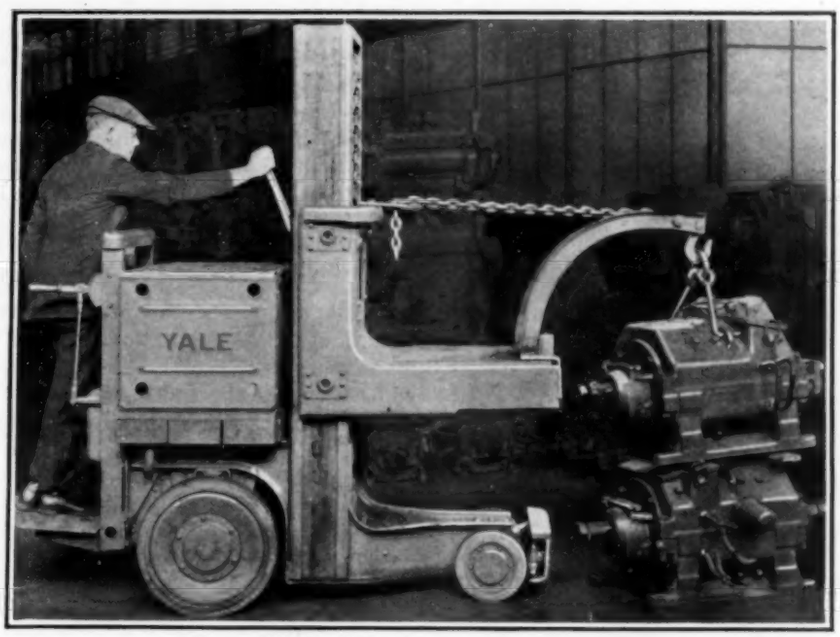


Fig. 1—Lifting a motor for transport

Often a slight modification in the design of the supports of a machine will greatly simplify the handling problem. Figs. 4 and 5 illustrate two machines, either of which may be picked up conveniently and transported by an ordinary lift truck of either the hand or electrically operated type. The lift truck is simply backed under the machine without the use of the usual

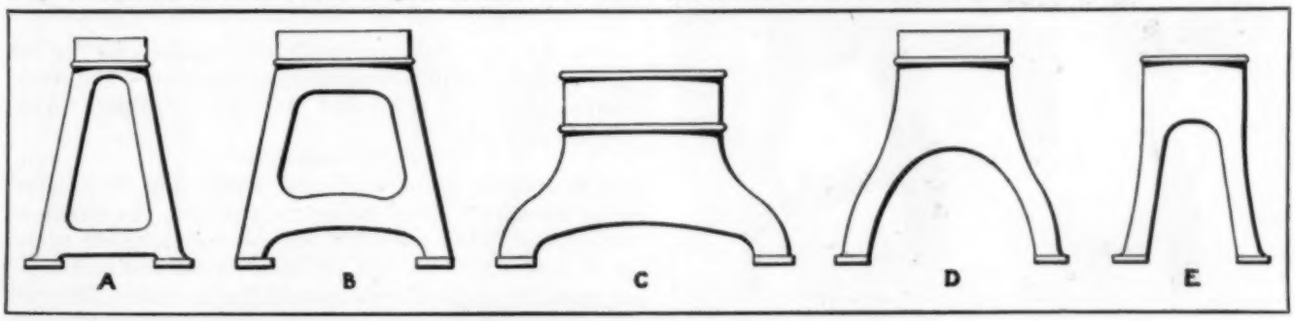


Fig. 2—Improper designs of machine supports

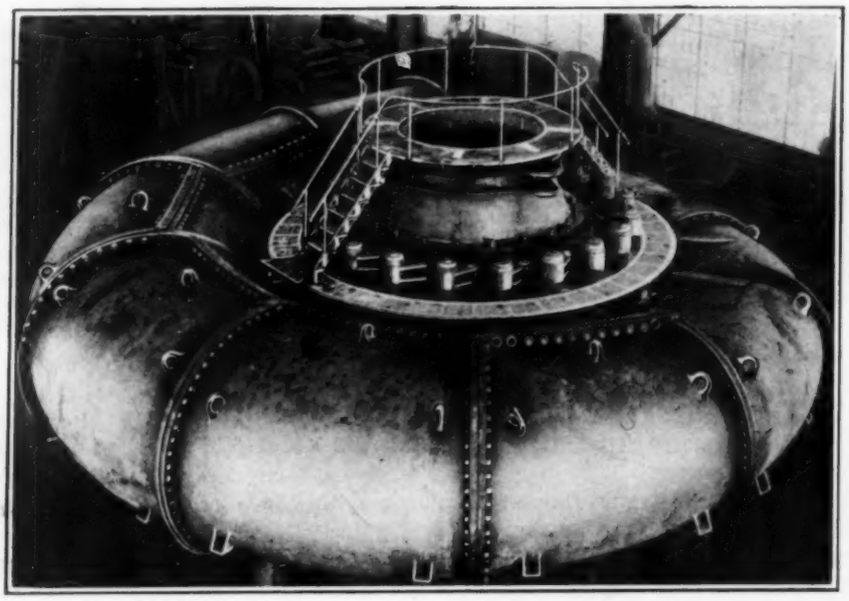


Fig. 3—Heavy turbine frame with means of lifting

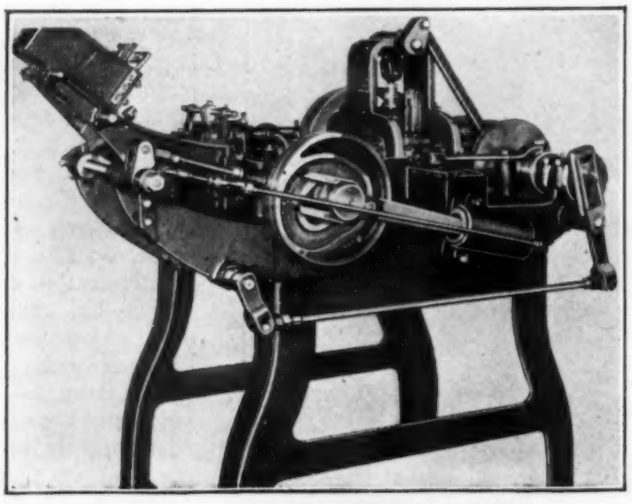


Fig. 4—Press with well designed legs

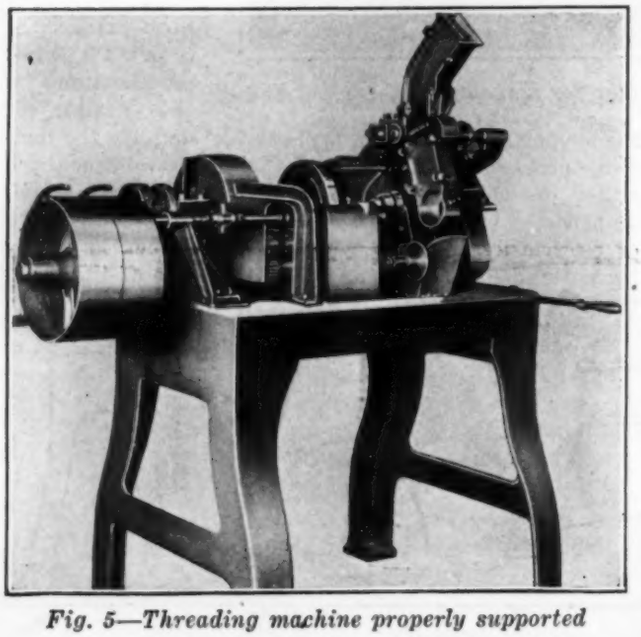


Fig. 5—Threading machine properly supported

wooden platform, and the machine picked up and transported to any part of the factory. It is advantageous to be able to handle a machine with the lift truck in parts of the shop not served by cranes. Also, the lift truck can be used to place the machine directly into freight cars for shipment. At the customer's end, it is a simple matter to remove the machine from the car if it can be handled by a lift truck.

The designs of machine supports illustrated in Fig. 2 are not suited for handling by lift trucks. But there is no reason why each of the supports at *A*, *B* and *C* could not have been modified in the original design, so that there would be sufficient floor clearance left under the cross member for the accommodation of a lift truck. The supports shown at *D* and *E* may likewise be modified for handling by lift truck, by simply adding a cross bar at the proper distance from the floor.

Material handling in industrial plants is recognized as a factor of importance, and the engineer-designer can do much towards simplifying the problem if he will always keep before him a mental picture of the work in process, and in its final disposition.

Brass Flanges for Composition Pinions

The recommended practice for brass flanges for composition pinions as adopted by the American Gear Manufacturers' Association in May, 1926, is S.A.E. No. 40 brass. This material is a good, cast red brass of sufficient strength and hardness to operate successfully without undue wear under conditions of style No. 2 (A.G.M.A. standard) composition gearing. In this style the flanges mesh with the mating gearing. Hence this material should also be ample for style No. 1. The composition is as follows:

Metal	Per Cent
Copper	83 to 86
Tin	4.5 to 5.5
Lead	4.5 to 5.5
Zinc	4.5 to 5.5
Iron	0.35 maximum
Antimony	0.25 maximum
Aluminum	None

Sound castings made from this alloy should give the following minimum physical characteristics:

Ultimate strength	27,000 lb. per sq.in.
Yield point	12,000 lb. per sq.in.
Elongation in 2 in.	16 per cent

The A.G.M.A. will appreciate any suggestions for the improvement of this recommended practice. The Association may be addressed at 2443 Prospect Ave., Cleveland, Ohio.

Idle time of machines costs money and may determine whether an installation pays or not. In one mine installation there were 726 hr. lost by electrical equipment and 1,679 hr. lost by mechanical equipment, in a year. There is always something to strive for, and fewer breakdowns is a very good goal to have in mind.

The Design and Manufacture of Hypoid Gears

By Arthur L. Stewart and Ernest Wildhaber
Gleason Works, Rochester, N. Y.

Offset axes of hypoid gears produce combined rolling and endwise sliding action—New method of production permits mathematically accurate tooth forms to be made at low cost

A PAIR of hypoid gears, having 13 teeth in the pinion and 64 teeth in the gear is illustrated in Fig. 1, and for comparison a pair of spiral bevel gears with the same numbers of teeth and the same diameter of the gear is shown in Fig. 2. The most striking difference between the two pairs is the offset of the pinion axis from the axis of the gear, on the hypoid pair. Another marked difference is the increased size of the hypoid pinion as compared with the bevel pinion. Furthermore, it is noted that the tooth inclination on the hypoid *gear*, or its spiral angle, is small, while the spiral angle of the hypoid *pinion* is as large as or larger than the spiral angle of the bevel pinion. These differences all have an influence on the performance and the characteristics of hypoid gears and will be discussed later on.

Names of men prominently connected with prior developments of hypoid gears in the last decade are those of H. D. Williams, G. M. Bartlett, R. M. Uhlmann, Reginald Trautschold and Nicola Trbojevich.

The new developments made at the Gleason Works comprise new tooth shapes for hypoid gears as well as new methods of production, and are covered by a series of pending patents. The tooth shape is derived from surfaces of revolution and permits the use of the usual type of rotary cutters for generating the teeth.

Two different types of tooth shapes and two corresponding methods of production have been developed. The earlier method consists in forming the gears without generation. A tooth space of the gear is then the exact complement or counterpart of the cutting surface of the tool. According to a general law of gearing, the tooth surfaces of one member of any pair of gears may be assumed at will, and the tooth surfaces of the other member are then determined or generated to suit the tooth surfaces of the first member. This is done by setting a cutter on a generating machine in such a way that it covers and represents a tooth side of the hypoid gear, and by providing the same relative motion between the cutter and the pinion blank which would exist when the pinion meshes with its mate gear.

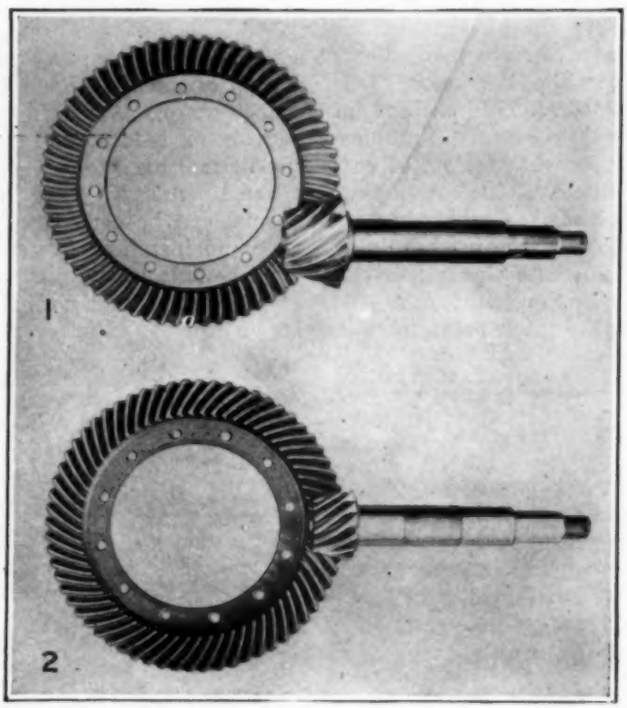


Fig. 1—Hypoid gear and pinion, ratio 13:64, gear diameter 12.8 in. Fig. 2—Spiral bevel gear and pinion, ratio 13:64, gear diameter 12.8 inches

The hypoid non-generated gears can be cut on the machines now used for roughing spiral bevel gears, but, to obtain the quality and accuracy required for finished gears, machines of higher grade than the gear roughers would be required. A later method permits of cutting the gears on the known standard generators exactly like spiral bevel gears. The pinions are cut in either case on a machine that differs from the standard generators by permitting additional adjustments. In the latter case, the generating roll is affected as if the pinion would roll and slide on a crown gear the axis of which is offset from the axis of the pinion.

The axis of the pinion is offset from the axis of the gear by an amount that varies with the diameters and with the ratio. Standard offsets of 1½, 2, 2½, 3, and 3½ in. are in use. The direction of offset determines the hand of the spiral. In rear-axle design a pinion below center will have a left-hand spiral, while one above center will have a right-hand spiral. The position below center is preferable for two reasons. First the axial thrust resulting on the pinion on forward drive is directed away from the gear, and heavy loads tend to move the pinion out of mesh rather than draw it in.

Paper presented at the summer meeting of the Society of Automotive Engineers, French Lick Springs, Indiana, June 1-4, 1926.

Second, the contact between mating tooth surfaces is more intimate on the drive side. This quality will be further explained in a later section. It is more pronounced on ratios such as are used on pleasure cars, than on the larger ratios used on trucks.

Objections to the above center position of the pinion, as far as end thrust is concerned, can be entirely eliminated by making the bearing and housing arrangements sufficiently rigid.

The offset of the axes is the cause of a certain amount of endwise sliding in the teeth. The teeth of hypoid gears should, therefore, extend lengthwise along such lines as to permit said sliding. Pitch lines of hypoid gears, therefore, are subject to restrictions, which do not exist on bevel gears.

As an illustration, we will consider the mesh between a crown gear and an offset pinion that is a special case of hypoid gearing. Referring to Fig. 3, *A* and *B* are what might be called respectively a pitch plane of a crown gear and a conical pitch surface of a pinion. The two pitch surfaces contact in a line *C*. The contact line between the two pitch surfaces may be called the line of action.

Evidently the action along line *C* is not changed, whether the conical surface *B* is considered, or whether the action of the pitch lines is analyzed in the development of the conical surface to the plane *A* of the crown gear. The developed pinion surface then rotates about apex *D* of the pinion, while the crown gear continues to turn on its axis *E*. This method of analysis is convenient, because it reduces the problem of conjugate pitch lines to the known problem of conjugate tooth profiles. Fig. 4 indicates the crown gear and the developed pinion surface. Considering an average point *H* on line of action *A*, the normal line *J* at this point with respect to two contacting pitch lines *B* and *B'* should pass through the point *K*. This point is what would be called the pitch point in ordinary gearing; namely, the contact point between two circles *L*, *L'* that roll upon each other without sliding, when the two bodies are turned at a constant ratio.

If the ratio between the crown gear and the developed pinion surface is assumed, point *K* is readily determined, and normal *J* is the connecting line. Conversely, the normal *J* at point *H* may be assumed and pitch point *K* determined as the intersection between normal *J* and the line *N* that connects the gear and pinion centers *D* and *E*.

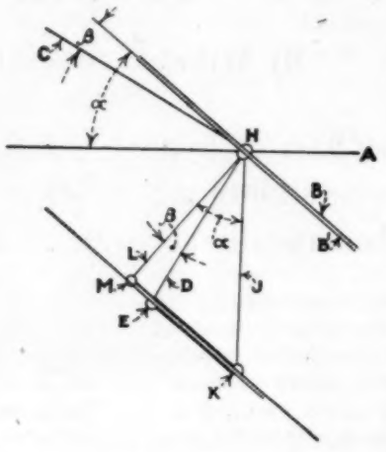


Fig. 5—Relative sliding between tooth surfaces

Another point of mesh on the line of action is *O*. The normal *P* to the contacting pitch lines at *O* necessarily must pass again through point *K*, just as in gears running on parallel axes *D*, *E*, the profile normal at any point of contact along the line of action (*A*) always passes through the pitch point. The motion of a normal itself from position *J* to position *P* can, therefore, be considered as a motion in which one endpoint of said normal moves along line *A*, and where the normal may slide along its own direction through a fixed point *K*. The instantaneous motion of the normal can be considered as an infinitesimal rotation about an instantaneous center *S*. The latter naturally must be on a line *T* that is perpendicular to the motion at point *H* of said normal; that is to say, perpendicular to line *A*. Moreover, the center must be on line

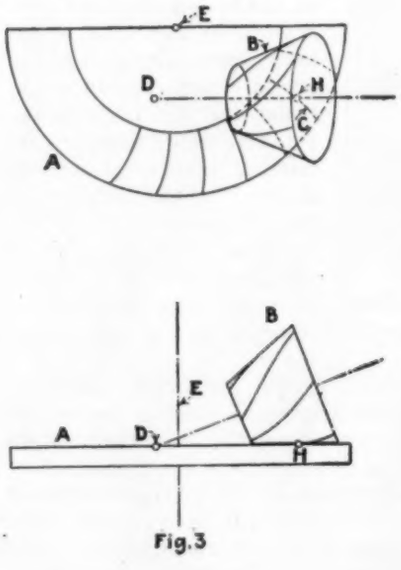


Fig. 3

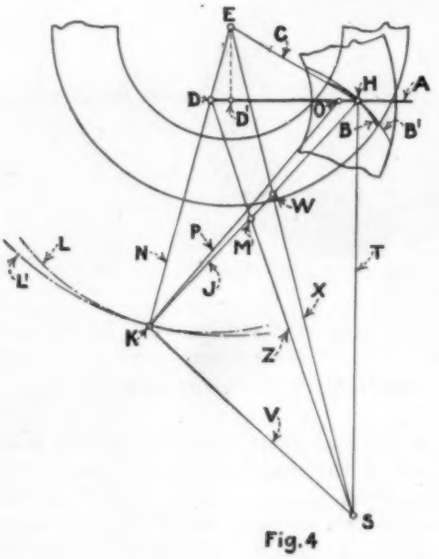


Fig. 4

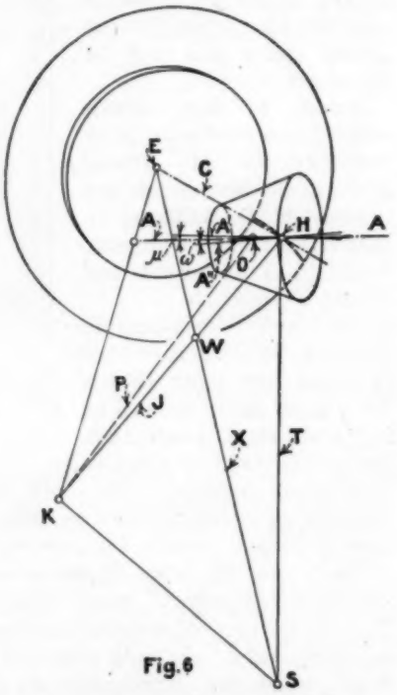


Fig. 6

Fig. 3—Graphical representation of a hypoid gear and pinion. Fig. 4—Contact conditions. Fig. 6—Modified line of action

V, which is perpendicular to the motion of the normal at K, in its own direction.

The center of curvature W of the gear pitch line naturally moves about center E. Inasmuch as it can also be considered as moving about instantaneous center S, it can only be situated in the connecting line X of instantaneous center S and center E of the crown gear; otherwise the direction of motion about center E and the direction of motion about center S could not coincide; that is, one motion would exclude the other.

The same considerations can be applied to the developed pitch surface of the pinion. The center of curvature M of the pitch line of the pinion is determined by connecting instantaneous center S with the apex D of the pinion by the line Z. The intersection point of this line with normal J is the center of curvature in the pinion.

Conversely apex D of the pinion could be determined, for instance, from the known radius of curvature of the pitch line B; that is, from the known location of center W. To this end, line T and line X are drawn. The intersection point S is projected to normal J at pitch point K. Apex D is found by drawing line N. If the pinion apex is located on a perpendicular through E to line of action A, that is at D', the above case coincides with the case previously treated by Nicola Trbojevich in analyzing the mesh between the pitch lines of a hob and a crown gear.

Having thus determined the interrelation between mating pitch lines of a pinion and of a crown gear, the next step is to apply this knowledge to a pair consisting of a pinion and a tapered gear. If the gear is nongenerated and the pinion is generated to match the gear, the same relations between mating pitch lines may be used as determined above for a pinion and an offset crown gear. The crown gear is then considered the development of the gear. In Fig. 4, if point E is the apex of the gear as well as the center of the crown gear, and line C is the projected axis of the gear, no error whatsoever is introduced thereby. If, however, both gear and pinion are generated, it is necessary to determine the pitch lines more accurately, as will be shown later on.

We will now consider lengthwise sliding at the contact point. Fig. 5 shows in a much enlarged scale the area of Fig. 4 around point H. B *and* B' are the contacting tangents at point H. During a small motion of the gear and pinion, the pitch line of the gear, shown as a straight line in this scale, moves in the direction D of the gear periphery; that is, in a direction perpendicular to line C. Point H of the gear then assumes a position E. The pitch line of the pinion moves in the direction of the periphery of the pinion, that is in direction J perpendicular to A. Point H of the pinion has then arrived at a new position K. Evidently, the distance between the points E and K is the amount of lengthwise sliding.

The rate of sliding can be expressed in percentage of the peripheral motion. This method will, however, result in two different values for gear and pinion, inasmuch as corresponding peripheral motions D and J are different. It is preferable, therefore, to express the rate of sliding in per cent of the normal motion L; that is, the displacement of tangents B and B' in the normal direction.

Let α and β be the spiral angles of pinion and gear respectively, as indicated in Fig. 5. Moreover s = sliding; n = normal motion. In Fig. 5, s equals distance EK, n equals distance L, or

s = distance MK minus distance EM

$$s = n \tan \alpha - n \tan \beta$$

$$\frac{s}{n} = \tan \alpha - \tan \beta.$$

It is noted that in hypoid gearing the peripheral motions D and J are at an acute angle to each other. For this reason, endwise sliding in the teeth is comparatively small. Moreover hypoid gears have a very high efficiency. The sliding action of hypoid gears is sufficient, in addition to the overlapping feature already existing in spiral bevel gears, to produce the degree of quietness in operation that is an outstanding factor in hypoid gears. For the same reason, hypoid gears can be lapped very well and rapidly.

It is a well-known fact that in a pair of helical gears set at right angles, or in a worm and wheel, the

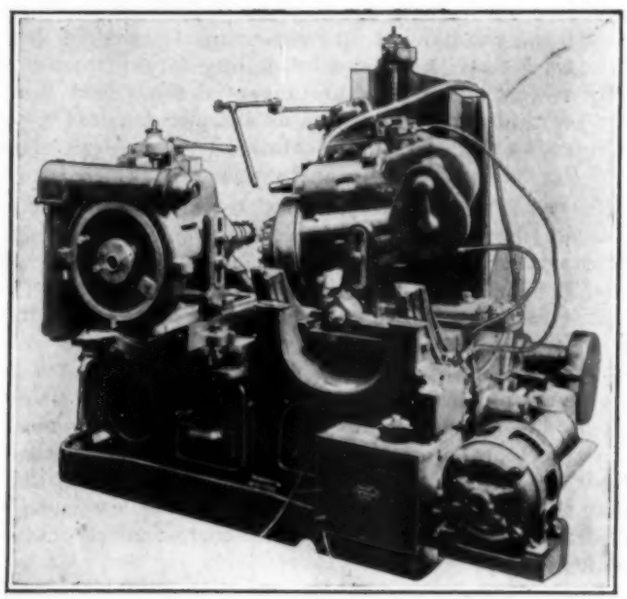


Fig. 7—Generation of a hypoid pinion

pitch diameters do not have to be in the exact ratio of the respective numbers of teeth. In consequence, the circular pitch is generally different on the two members of a pair, and only the normal pitch is equal.

The same holds true for hypoid gears. The circular pitch of the pinion and the circular pitch of the gear are proportional to the corresponding peripheral movements J and D, see Fig. 5. Their ratio evidently equals

$$\frac{\cos \beta}{\cos \alpha}$$

the inverse ratio of the cosines of their spiral angles. The hypoid member with the larger spiral angle has the larger circular pitch. The pitch diameters themselves are proportional to the circular pitch and to the number of teeth. The spiral angle α of hypoid pinions is being made 35 deg. or 40 deg., depending on the tooth number in the pinion, while the spiral angle of the gear is being kept around 5 to 15 degrees.

In consequence, the average pitch diameter of a hypoid pinion is increased over the average pitch diameter of a corresponding bevel pinion by twenty to thirty per cent, the gear diameter being the same. This naturally increases the strength of the hypoid pinion. More-

over, it is possible to effect large ratios with hypoid gears where it is difficult to obtain them with the spiral bevel gears on account of prohibitively small pinion diameters. An even larger percentage of diameter increase may be obtained by increasing the spiral angle of the pinion. At a 10 to 1 ratio, a hypoid pinion of 1.75-in. pitch diameter may be made to mesh with a gear of 10-in. pitch diameter, while a corresponding bevel pinion would have a pitch diameter of only 1 inch.

In computing the tooth loads of a pair of hypoid gears, the circumferential or tangential tooth load P of the gear at the center of the face may be determined from the known torque, and the pressure or load normal to the tooth surface is then determined by dividing P by the cosine of the normal pressure angle ϕ and the cosine of the spiral angle β of the gear.

$$P_n = \frac{P}{\cos \phi \times \cos \beta}$$

This amount P_n is the total tooth load, or in other words, the resultant of all components. It is noted that this total tooth load is only slightly larger than the effective circumferential or tangential tooth load P of the gear, for if we introduce as average amounts $\phi = 17\frac{1}{2}$ deg. and $\beta = 8$ deg., we obtain

$P_n = 1.06\ P$; that is, an increase of 6 per cent.

In spiral bevel gears the total tooth load P_n is considerably larger than the effective tangential tooth load. If a pressure angle of $17\frac{1}{2}$ deg. and a spiral angle of 35 deg. is assumed, the total tooth load is $P_n = 1.28\ P$; that is, an increase of 28 per cent as compared with 6 per cent.

The analysis of the tooth profiles of hypoid pairs is somewhat tedious and cannot be carried out in a single plane. All hypoid pinions have the feature in common, that the tooth profile of one side is more curved than the tooth profile of a corresponding bevel pinion, and that the tooth profile of the other side is less curved or flatter than the profile of a corresponding bevel pinion.

Taking the average of opposite tooth profiles, it may be stated that on hypoid-gear pairs in general the tooth profiles are similar to those of spiral bevel gears. Opposite tooth profiles of hypoid pinions are, however, differently curved. The concave tooth side of the hypoid pinion contains a flatter profile than the convex tooth side. Partly on account of this difference in curvature, the different pressure angles of $17\frac{1}{2}$ deg. and 20 deg. are being used on the drive side and the reverse side respectively, that is on the concave and the convex sides of the pinion teeth.

The surface stress of contacting teeth, that is, the stress of the tooth surface along the line of contact at the moment of contact, is a very important quantity, inasmuch as it is the decisive factor on life and wear of the gears. As is well known at present, wear of properly lubricated surfaces is practically zero at various rates of sliding, as long as the surface stresses are kept below a certain limit, which depends on the material used. Surface stresses may be computed with the Hertz formulas, which are widely used in computing the stresses in ball bearings and in roller bearings.

We will first compare helical teeth and straight teeth. When calculating the surface stresses in helical gears and in straight spur gears with the Hertz formulas, and considering the total length of the line of contact on the various teeth in simultaneous contact, it is found that helical teeth and straight teeth are practically equivalent with respect to surface capacity; for, although the tooth contact is more intimate in helical gearing, the depth of the helical teeth is smaller, being in a constant proportion to the normal pitch, and the normal or total tooth load is larger on helical teeth for the same torque transmitted. The result can be directly applied to spiral bevel gears and straight bevel gears.

The intimacy of tooth contact of hypoid gears is substantially the same as in spiral bevel gears, if the average of opposite tooth sides of hypoid gears is taken. But, comparing pairs of equal diameter of the gears, the total load on hypoid gears is considerably smaller than on spiral bevel gears. Moreover the tooth height, being at a constant proportion to the normal pitch, is larger. Because of these two factors hypoid gears are able to carry a considerably larger load under equal surface stresses, as compared with spiral bevel gears or straight tooth bevel gears.

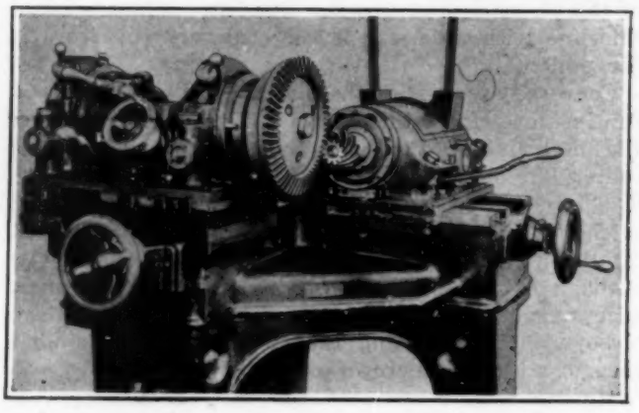


Fig. 8—Testing and lapping a pair of hypoid gears

The figured loads are at a proportion of

$$\left(\frac{\cos \beta}{\cos \alpha}\right)^3$$

This proportion is given below for three cases; namely, for spiral angles α at the pinion of 35 deg., 40 deg., 45 deg., and corresponding spiral angles β at the gear of 5 deg., 10 deg., 15 deg. The proportion is 1.48, 1.66 and 1.87 in the three cases. Hypoid gears have theoretically a surface capacity increased by 48 per cent, 66 per cent and 87 per cent over the surface capacity of spiral bevel gears or straight bevel gears for equal diameters of the gear. These figures refer to the average surface capacity of opposite tooth sides. The surface capacity of either side is somewhat different. Usually the drive side contains the larger surface capacity, that is, a capacity still larger than given above.

The two methods of production developed by the Gleason Works have already been mentioned. The earlier method, in which the gear is cut without a generating roll, is theoretically accurate; that is to say, it does not contain the least theoretical error or approximation.

This method has now been discontinued in favor of another new method that gives just as good or better results on account of its increased flexibility and incidentally permits the use of the present generators on the gears. We will limit our explanations to this method. It will be seen that the method has been

worked out mathematically to a high degree of perfection and is not based on any assumption, of which the effect is not entirely known. Although somewhat long in figuring, this method is very practical in operation and permits of refinements not previously available.

According to this method, the gear is cut exactly like a spiral bevel gear of the same pitch angle. In the production of the pinion a Gleason generator with additional adjustments is used, and the pinion axis is offset from the axis of the cradle. The cutter is of the usual Gleason type having straight cutting edges, which are at an angle to the axis of the cutter. Preferably different cutters are used on gear and pinion. One gear cutter and one pinion cutter can cover all cases. It is not necessary to use cutters with varying amounts of pressure angle correction, as has been the practice with spiral bevel gears. During the generation, the cutter represents a crown gear with an offset axis that is conjugate to the pinion. A generating motion is provided between cutter and pinion blank as if the pinion would roll on the crown gear.

Contact Conditions

We will now analyze briefly the mesh between a hypoid pinion and its mating gear:

In Figs. 3 and 4, the mesh between a pinion and a crown gear was illustrated. It has been found that, if the teeth extend along certain pitch lines, either side of the teeth meshes along the same line of action in the pitch plane of the crown gear; that this line of action is independent of the pressure angles, and that the projected tooth normals of either tooth side intersect at the same point.

Somewhat analogous conditions can be determined in the present case, where the mesh in a pitch plane between two hypoid gears is considered, whose axes are inclined to said pitch plane. In Fig. 6, pitch surfaces of gear and pinion are tangent to a common plane selected as the drawing plane. Lines C and A are the projected axes of the gear and the pinion respectively and also the contact lines between the pitch plane and the pitch surfaces.

However, in contradistinction to the former case of pinion and crown gear, the line of action of the same character cannot extend along line A, but extends along line A', which is inclined by a small angle μ to line A. The relation between the location of points K and W can be determined in a manner analogous to the one explained with reference to Fig. 4; that is, point K may be determined by drawing line X connecting points E and W and by drawing line T through point H at right angles to line of action A'. The intersection point S is then projected to normal J, thus locating point K. Instead of using a graphical solution as illustrated by the diagram, the location of this point and of all other points can also be determined by calculation, which is more accurate, and which is exclusively used at the Gleason Works.

The normal pressure angles along points O of line of action A', that is, the inclinations of the tooth normals at points O, can be determined from the known structure of the gear and the cutter that produces it. They change slightly along the tooth and are also different from the pressure angle of the pinion cutter except at point H. In order to cut a pinion with pressure angles exactly matching those of the gear, along the whole length of the teeth, another line of action A'' is determined for the mesh between the pinion and its crown gear, represented by the cutter. The mesh during generation extends, therefore, along a line A'', different from the line of action A' of the pair of hypoid gears. Line A'' is inclined by a small angle ω to line A. The final step is to determine a crown gear that is able actually to mesh along the figured line A'' with the pinion, and that contains tooth sides that are conical surfaces of suitable diameter. A tooth side of this crown gear is then represented by a cutter, and the pinion is generated while meshing with said imaginary gear.

By means of the developed method, tooth surfaces may be produced that match those of the mate gear along the whole length and depth of the profiles. However, for reasons of adjustability, that is, to provide a certain range of running positions and to allow for non-rigid mounting, the bearing area of the teeth is preferably somewhat restricted, especially in the case of rear-axle drives. Any desired deviation on the profile from full bearing may be obtained lengthwise of the teeth and on the depth. More curved or less curved tooth profiles on the pinion are obtained by changing the offset between the pinion and the crown gear, after refiguring the settings. It has been previously pointed out that on the tooth side of the pinion, which during the mesh is opposite of the axis of the gear, an increased offset requires a flatter profile. If, therefore, on this side, which is usually the drive side, the offset is increased during the generation, the resulting profile will be flatter; and if the offset is reduced, the resulting profile will be more curved. The opposite holds true for the tooth side of the pinion, which is on the side of the axis of the gear or crown gear.

Bias bearing, that is, a tooth bearing that extends obliquely across the tooth surface and has been found objectionable in certain cases of curved tooth gearing, results when the pressure angles of gear and pinion do not match along the whole length of the teeth. The pressure angles of hypoid gears are made to match along the whole length of the teeth and bias bearing is thus entirely eliminated.

Another feature illustrating the flexibility of the method of cutting is the fact that the tooth bearing of a pair of hypoid gears under production can be raised or lowered, or moved endwise, by simply changing the cutter setting. If it is desirable, for instance, in order to counteract hardening changes, to shift the tooth bearing, the tooth bearing can be placed readily on any desirable spot on the tooth surface whatsoever.

Manufacture of Hypoid Gears

Production operations are, in general, the same for hypoid gears as for spiral bevel gears. These include preparing the blanks, cutting the teeth, hardening, grinding bores and shanks, and lapping the teeth. The blanks are turned to different dimensions, being larger in the case of the pinion, and of slightly different face and back angle and outside diameter in the case of the gear. Machines for rough-cutting the gear and pinion and for finish-cutting the gear are the same as used for spiral bevels. The pinion finish cutting machine has additional adjustments for setting purposes, after which the cutting operation itself is the same. The added settings are a vertical adjustment of the work spindle

in accordance with the offset of the pinion with respect to the gear, and two angular adjustments of the cutter spindle about horizontal and vertical axes respectively. These adjustments are clearly seen in the illustration, Fig. 7. In the testing and lapping operations, machines must have the same offset of work spindles as the pinion and gear shafts are to have in final assembly. Fig. 8 shows a pair of hypoid gears on the testing machine.

In cutting pinions, it is found advantageous to cut the top side on one machine and the bottom side on another machine. This saves time as nearly all the machine settings have to be changed in going from the top to the bottom side. Pinion cutters are then made with all outside or all inside cutting edges, so that the speeds of the machines may be increased. Cutters of 9-in. mean diameter are used in all cases of hypoid gears up to date.

It will be seen from the above that the production cost of hypoid gears will vary but little from the cost of spiral bevel gears. Cost of blanks will be changed only in the case of the pinion, where the increase in diameter will call for a slightly larger forging. If advantage is taken of the additional load-carrying capacity and the gear diameters are reduced, additional cost of pinion blanks will be offset. Cutting cost for the pinions will be slightly less on account of using all inside and all outside blades on the cutters.

The use of a ring gear of smaller diameter and the location of the rear end of the propeller shaft will influence chassis design. On account of the capacity of hypoid gears for greater transmitted load, a decrease of about 10 per cent in ring gear diameter can be made without increasing unit stresses. This makes possible a greater road clearance. The lowered position of the driving pinion removes the chief obstacle to lowered floor boards at the rear ends. Advantage can be taken of this to lower the whole body.

A very practical point of advantage for any present user of spiral bevel gears, who is considering the adoption of hypoid gears, is that the change can be made with but slight change in manufacturing method or equipment. As has been already pointed out, the finish-cutting of the pinion is the only major operation requiring machinery different from that used for spiral bevel gears and pinions.

A Blackboard in the Shop

By Frank V. Faulhaber

A valuable adjunct to any machine shop is a blackboard that can be rigged up in a convenient place. Toolmakers particularly, will find it a handy and useful article. It will permit the outlining of sketches and other drawings. It is especially valuable where much experimenting and erasing is necessary, and enables the user to plan the work in larger, clearer detail. Besides, it proves a paper-saver. Another important part the blackboard can play is in the case of the instruction of new employees, and also on new and intricate jobs, where detailed points must be discussed. Aside from the saving of effort and time, the use of the blackboard will eliminate the possibility of many errors, and insures quicker and better work.

A blackboard in the foremen's meeting room is handy for illustrating points under discussion.

Locating a Job—Discussion

By George Cormack

THE appeal "To employers who advertise for men," in the searchlight section of the *American Machinist* of March 11, interested me greatly. Whether or not it will bear fruit is problematical, but there can be no doubt about the necessity for such an appeal. For the salaried man the problem of getting in touch with a new position in the production end of the machine business is not an easy one, unless he is located in a city where the manufacture of machines has a leading position among its industries.

What follows is from my own experience. I am fifty years old and have been all my life in the machine business as apprentice, machinist, toolmaker, foreman, designer, and superintendent. Most of my experience has been in the design and manufacture of internal combustion motors. I have been a reader of the *American Machinist* for thirty years, and would occasionally send in an application for some position advertised in its columns. I cannot tell just how many of such advertisements I answered, but it must have been over twenty. I always felt that if a better position showed up I would take it.

All the replies I received were two. One said my application had been received and placed on file. The other was a post card stating that the position I applied for had been filled. In spite of the fact that I had given my home address, and had stated that my application was to be treated in confidence, the post card was addressed to me in care of the firm for which I was working, and nearly cost me my job.

A year and a half ago, I found myself out of a job, and for the first time in my life really had to look for a place. I answered every likely advertisement in the *American Machinist* and in other papers. Replies were few and many did not reply even when stamped envelopes were inclosed. I was not looking for any fancy job; I have a clean record and the very best of references. I was not looking for a salary out of proportion to my experience and ability. I was looking for a place where the work would be congenial, and where I could find a use for my experience.

But, briefly, the attitude of the average manufacturer toward applicants for positions in the production end of the business is not too courteous. Every "help-wanted" advertisement in the *American Machinist* is addressed to men of intelligence and merits a courteous reply.

This attitude of the managers of production towards applicants for positions is in striking contrast to that of sales managers. In my hunt for a job I made several applications for positions as a salesman, and in every case the response was immediate and courteous. Finally I gave up all hope of getting a position in the manufacturing end of the machine business, and found a place with a distributing agency that handles well-known oil burners over a large territory. My job is not that of a salesman, but as an installation and trouble man. This job was entirely new to me, yet in a year's time I have been able to gain enough experience to be able to speak with authority and command a good salary.

At the present time the sales end of industry is offering far greater opportunities and better remuneration to men of all ages than does the factory, and it is reasonably certain that unless the factory heads change their attitude they will find increasing difficulty in obtaining the best kind of men.

Foreman Training Is Essential to Plant Self-Government

The prime object of foreman training is to obtain the correct application of company policies—Influence of foremen on production, quality and cost—Promotion within the ranks

By Cyrus McCormick, Jr.
Vice-president, International Harvester Co.

EXPERIENCE in industry records that the progressive, alert, keen, ambitious worker of today is the foreman of tomorrow and the executive of the future. It is obvious that management should make easy the progressive road for ambitious employees to reach the goal of executive leadership. Foreman training involves not merely reinforcing the ability of a department head but also instructing the future executive.

In order to face squarely our problem today, it is necessary to look back and note briefly the important changes in our industrial system. Let me merely refer to the small factory employing a handful of men with the owner in sole charge of everything. A little later we find the growth of the business necessitating a partner. Soon the economic evolution brought about many partners and finally resulted in the industrial situation of today; stockholders, directors, officers, departmental managers, foreman, workers—all, in a sense, employees of the company. When the owner of the small factory had to delegate authority, and so created foremen, he placed himself, as far as the good will of his workmen was concerned, in the hands of individuals. Where formerly the owner had been hiring and firing the workers, setting rates, figuring costs, repairing machines and the like, the foreman now took over these tasks and represented the owner. The correct application of company policy is then the prime object of foreman training.

Of course the foreman must also be trained in the routine of his job. No manager of other men can properly direct activities unless he is reasonably well instructed in the details of the work under his supervision. Too many men feel that they can leap divinely over technical training and hard-won experience, but a foreman cannot be successful unless he knows the elements of his profession, just as a salesman cannot be really successful, if he relies solely on "high-pressure" methods and omits a constructive understanding of his line. A fundamental object of foreman training, therefore, is to fortify men with experience.

The subdivision of modern industry into departments makes this experience all the more necessary, but it also makes it easier to acquire. To the old time foreman this new form of organization may seem an encroachment on his duties and responsibilities. The specialists all seem to be insisting on the administration of their respective departmental plans and we come, therefore, face to face with the present-day problem of the foreman. The solution seems to lie in getting all ranks and kinds of men to understand a few fundamental points:

1. The foreman is still absolutely responsible for the supervision and for the product.
2. The various departments of the business headed by specialists should, in their respective work, be looked upon by the foreman as service departments, helping him to meet his voluminous obligations to the company and to his workers.
3. The new order of things leaves the foreman in a position to devote more time to the real job of production and management and to the training of the men around him.

> A company's labor policy is no sounder than the actual working policy of each of its foremen. Employee representation, for example, cannot function if a foreman disbelieves in this method of industrial relations so profoundly that he cannot square his acts with this policy. The foreman, after all, must apply all personnel policies

We commission the foreman with responsibility for producing harmoniously goods of high quality at low cost, for the instruction of new men and the supervision of both new and old employees, and for liason between the management and the employees under him.

Thus a company's labor policy is no sounder than the actual working policy of each of its foremen. Employee representation, for example, cannot function if a foreman disbelieves in this method of industrial relations so profoundly that he cannot square his acts with this policy. Business may create departments to develop personnel policies, but the foreman must be the one to apply these. The same thing is true of inspection standards, cost data, rates of pay, and so forth. Any movement or action by the management that fails to recognize this fundamental principle of organization must eventually be disappointed. It goes without saying, therefore, that if a company desires to install a system

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Abstract of an address presented at the 14th annual meeting of the Chamber of Commerce of the U. S. before the Department of Manufacture Group, Washington, D. C., May 12, 1926.

of employee-representation, or to see its employees become stockholders, or to improve the quality of its product, it must convince the foreman first of the inherent need for these things.

We can agree readily that the three outstanding problems of industry are maintenance of production, reduction in cost, and improvement in quality. Underlying these three is the development or training of man power. Of these, production is the simplest, since it is easy to measure the success or failure of any given department in terms of the volume of production passed through that department. A foreman knows quickly, without being told, whether he is successful or not in producing his required quantity.

It is not so easy to reduce costs by means of foreman training as it is to increase quantity. Men have long since become skilled in assessing quantity, but an understanding of costs has hitherto been regarded as the province of the factory auditor. Reduction in cost is not merely dependent upon the provision of the best possible mechanical appliances, but it also requires an understanding of all the elements that go to make up cost. Industry is overlooking an important item if it does not use the foreman as a means of developing quality. Here education depends upon understanding, which can be best acquired by familiarity with the problem. The foreman must be put into direct contact with the demands of the sales department and the needs of the consumer.

Penalties and Rewards

The development of men is an all-important subject that presents some extremely interesting phases. The turnover of men in executive positions is large, because our executive system is a very just taskmaster. It penalizes those who do not succeed and it rewards with early promotion those who have done a little more than they are required to do. There is thus a steady progression of management training foreman, and foreman training understudies.

Our schools and colleges, in greater or less degree, teach men how to think, how to concentrate, and how to educate themselves, but many big men of today, without the benefit of a college education, early in their careers learned how to think constructively and to educate themselves. This process of self-education is within the reach of every man, but industry has an obligation in aiding its organization in self-education. As a corollary to this, industry has just as great an obligation in providing its men with the new tools of an ever enlarging trade.

Promotion from Within

We believe in the soundness of the principle of filling all vacancies from within our organization, whenever possible. When this proves to be impossible we ourselves have failed in training a man for a given position. We practice the belief that no man has ever been injured by training under him a man better equipped for his position than he is himself.

This form of training is a continuous process that requires patience and perseverence. It places a tremendous responsibility upon the executives of an organization, because they, through their personality, affect the men under them. The juniors will seek to discover the secret of the success of the executive and will thus try to qualify for the position should their superior be promoted. The force of example is a most potent training influence.

I am profoundly conscious of the fact that promotion of a man from the ranks to the position of an assistant foreman is made by an executive whose experience is very little larger. In seeking for a method to interest this foreman in thinking constructively on this score we must first remove the mystery that has surrounded promotion. Let him know that he is being examined and studied with the view of placing him in a better job, and then get him to assess the men under him in the same way. In our company we do this by maintaining a file of progressive employees. In this file are listed all men who are qualified by additional experience for positions of high executive responsibility within the organization. These men are analyzed and their qualifications rated, thus giving us an inventory of their strong or weak points. Through this information we are able to assist any particular man in fitting himself for a better position. It is this direct analysis and special training that will automatically provide the future executives of an organization.

Two Classes of Students

A training program should meet two specific problems. First, where men now employed show outstanding progressive qualifications, they must be given technical or general shop training. Second, school boys or college men, whose theoretical education has been full, must be brought into our factories and qualified for executive positions by a training in shop practice. The young shop man will all too frequently, as his training progresses, fail to develop intellectually, as the school boy will just as frequently fail to appreciate the need of a sound body of practical experience. Industry cannot afford to favor too strongly either class of student, and the needs of executive leadership are such that it must keep on trying to develop both.

The factory manager himself is the best instructor of the foreman or of any other form of potential executive. His example will be more efficacious than a score of lectures. Strong men beget strong men. If you desire leadership tomorrow, see that you have it today.

Credit Where It Is Due

By Frank C. Hudson

I am as glad as anyone that Commander Byrd was successful in his first flight to the Pole. And I'm sure he has no idea of taking all the credit—for we naturally think of Byrd as typifying all those who had a hand in it.

It reminds me of an incident that happened years ago when locomotives all wore names and when, as now, the conductor thought he ran the whole train. The old John I. Blair, aided by the engineer and fireman, had coaxed a long train up Pocono Mountain and the conductor was bragging about it at the top of the hill. The engineer got a bit sore, because said conductor always took a nap coming up the hill, as was perfectly proper—if he'd been contented not to brag. But the habit was so strong that he burst out with "Well, boys, I pulled 20 cars up the hill this morning." And the engineer, who got peeved at the way it was put remarked: "Yes, and the John I. Blair was asleep in the cab all the way up."

Here is a case where "we" not only would have sounded better but been nearer to the truth.

Electric Heat for the Machine Shop

By P. F. Creasy
General Engineer, Westinghouse Electric and Manufacturing Co.

Variety of applications of electric heat—Uniformity of product and better working conditions claimed—Cost only one factor

ELECTRIC heat has already been recognized as an important aid to the industrial world. The arc and induction furnaces are well established as industrial servants. The medium and low temperature applications, though representing a relatively new field for electricity, embody a class of apparatus rapidly becoming an industrial requirement. This lower temperature apparatus may be classified as the metallic resistor type, and is for use in applications requiring temperatures not in excess of 2,000 deg. F.

The use of electric heat over this range of temperatures may be justified by a number of advantages already demonstrated by the results obtained from a great variety of applications. Improved quality and uniformity of product, reduction of rejections, and greater output, have been cited in its favor. Reduced floor space, better working conditions, reduction of fire hazards, flexibility or portability may be other determining factors. Electric heat is also more adapted for automatic control, thereby reducing costly personal supervision and guess work. In fact, it is playing an increasing part in the modern trend of manufacturing.

The machine shop is no small user of heat. With its multiplicity of processes and operations it presents a field of varied application, but a comprehensive viewpoint can be obtained by a discussion of a few of the more common applications and a description of the apparatus which has been developed to meet their requirements.

Almost every shop maintains a hardening room, which, with modern production methods, has evolved into a real heat treating department. Generally this department is the biggest user of industrial heat, and its standard is the box type furnace. Batteries of these furnaces are in continual use, hardening dies and tools, annealing and normalizing, carbonizing, and case hardening parts. These furnaces must be of rugged construction to insure continuity of service. They must be designed to give temperature uniformity in order that the work may be evenly treated; they must be automatically controlled so that the work will be treated at the correct temperature. As these furnaces are usually in continuous operation they should be well insulated and constructed to secure economical operation.

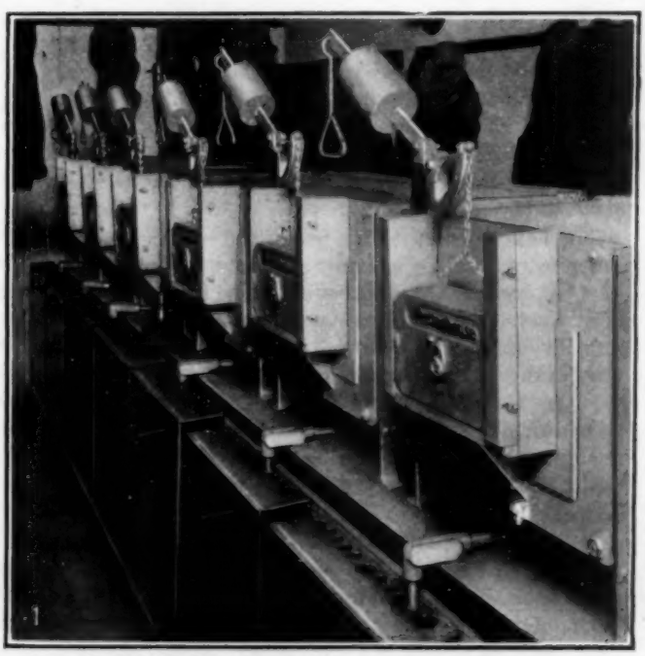


Fig. 1—A typical small furnace installation

These laboratory size furnaces are being used for annealing glass lenses. They are operating at temperatures up to 1,650 deg. F. Each furnace is 8 in. wide, 12 in. deep and 5 in. high inside measurements.

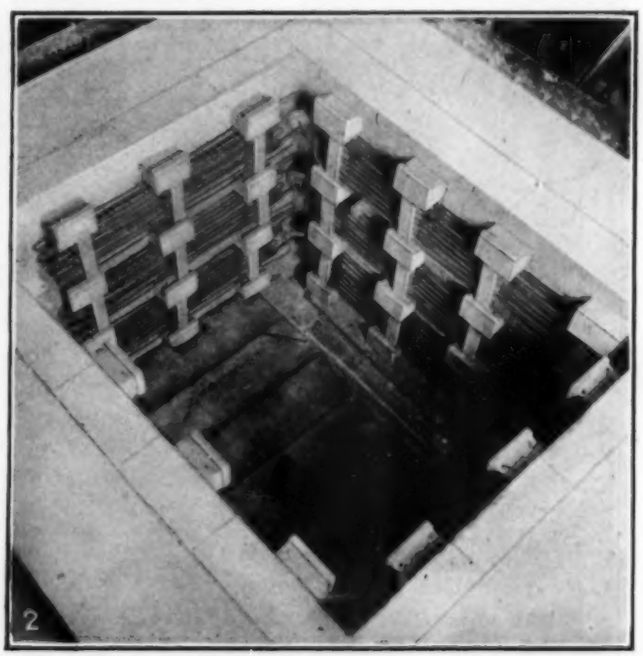


Fig. 2—A large pit type furnace

This furnace is used for annealing magnetic iron at 1,800 deg. F. It will hold 35,000 lb. and is 34 in. by 44 in. by 36 in. deep. Note the radiant type heating elements on the walls. The capacity of the furnace is 75 kilowatts.

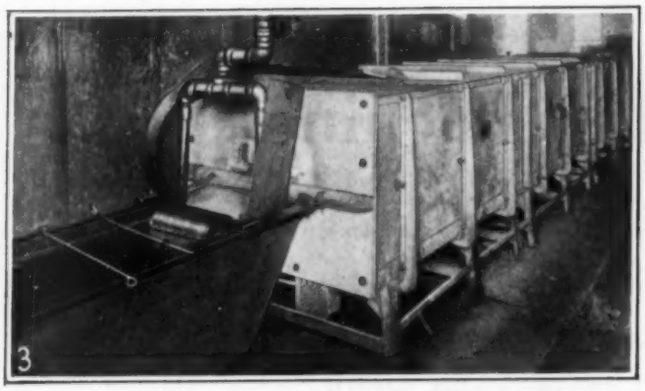


Fig. 3—Hardening wire by electric heat

The steel wire is being drawn through a tunnel furnace and quenched in oil. Non-exposure to the atmosphere is essential to prevent spoiling the bright finish by oxidation

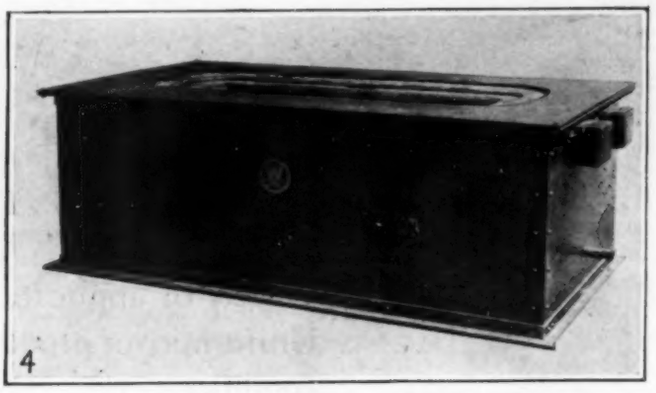


Fig. 4—Electric heat-treating lead bath

The crucible is 60 in. long, 14 in. deep, and 12 in. wide. It operates at a temperature of 1,600 deg. F. in the bath and is adaptable to continuous treating of parts.

Electrically heated furnaces designed to meet these demands are in successful operation at the present time, and are available on the market in sizes varying from the small laboratory unit to the largest requirement of the heat-treating room. Outside of the hardening room this type of furnace finds many applications to which it is particularly adaptable. Frequently a heating operation occurs in the line of production where it is difficult to install a fuel fired furnace, and as a consequence considerable time is wasted carrying the material to and from the heat-treating room. Such cases as heating pieces for bending or punching, enameling small parts, or heating rivets may be cited as examples. Electric furnaces fit nicely into the line of production because they are compact, they give off no deleterious or disagreeable fumes, are quiet in operation, and are automatically controlled. Figure 1 shows an installation of small electric furnaces lined up for annealing glass lenses.

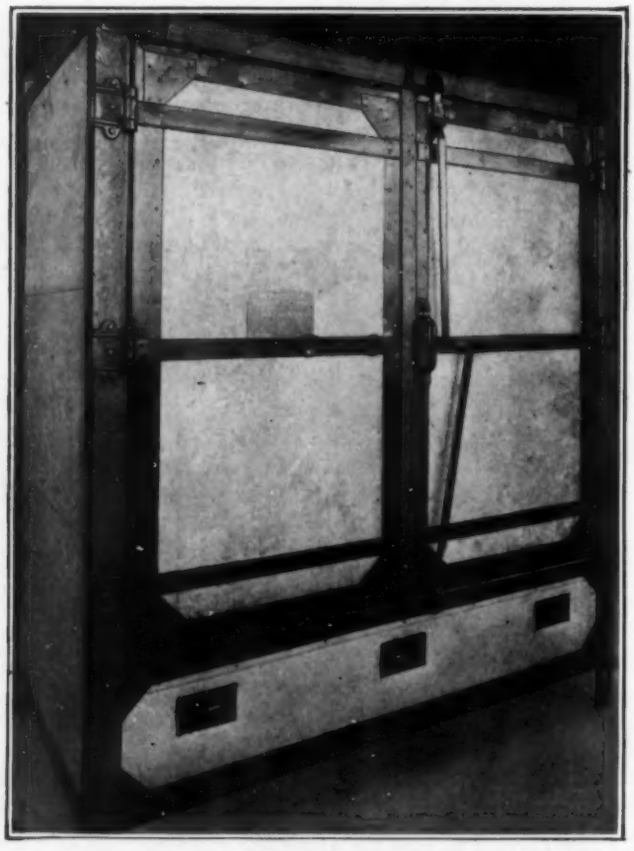


Fig. 5—A standard industrial oven

This electric oven is 66 in. wide, 58 in. high, and 36 in. deep inside. It operates up to temperatures of 800 deg. F.

For certain applications a furnace of the pit type, Fig. 2, can be used to better advantage than the box type. The shape or size of the piece to be heated may be such that it is more readily charged into a furnace from the top. Long rods and pipes are usually easier to charge from the top, and heavy or bulky objects can usually be lowered into a furnace by tongs or by a crane more easily than by lifting them to the hearth level. In such cases the furnace is often lowered beneath the level of the floor, which would be difficult were the furnace to be fuel fired.

Small parts of uniform size and shape may be charged by gravity where production conditions warrant. The pieces may be removed manually or mechanically from a side opening at the bottom or by means of a bottom door, depending upon the next operation. Where the work is to be quenched it may be dropped through a bottom door directly into a quench tank beneath, and by means of an extension of the furnace chamber into the quenching medium the furnace may be made air-tight in order to prevent exposure of the work to the atmosphere.

The flexibility of design permitted by the use of metallic resistor electric heating elements gives this form of heat a decided advantage over the more cumbersome and unwieldy fuel burning designs for applications of a unique or special nature. This feature combined with other inherent advantages already enumerated accounts for the rapid growth in the use of electric heat for mechanically operated and continuous types of furnaces, such as the wire hardening furnace shown in Fig. 3, and for furnaces interposed with the line of production.

Most heat-treating departments are equipped with one or more lead pots for the heat treatment of small and miscellaneous parts. Many heat-treating problems have been, and are being, solved by the use of a lead bath. One outstanding feature of lead treating is the fact that, other conditions being equal, absolute uniformity of product is assured. The good heat conductivity combined with slight convection action within the bath keeps the lead uniform in temperature. Its high thermal capacity, or heat storage quality, eliminates the sudden fluctuations in temperature caused

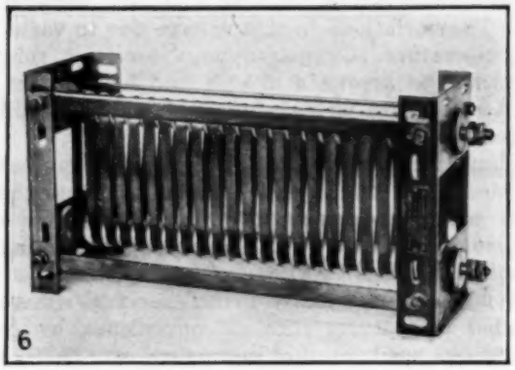


Fig. 6—A unit oven heater

This unit oven heater is rugged and of varied application. It can be mounted in almost any position, and is often used for electrifying ovens already constructed

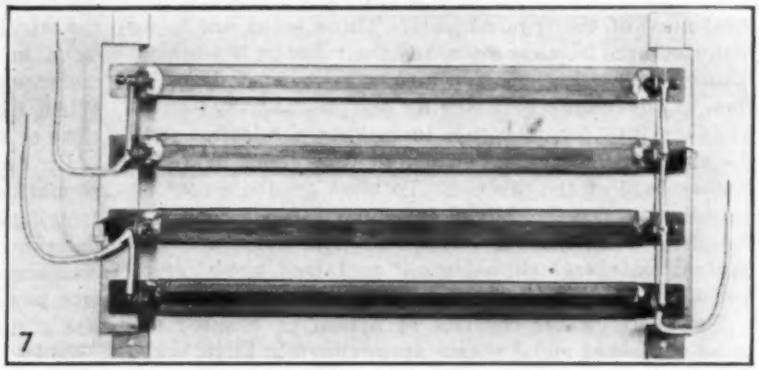


Fig. 7—Local heat with space heaters

A group of four electric space heaters mounted on the walls of isolated buildings such as crane cabs or watchman shanties make a cheap method of heating.

by the introduction of a new charge as in an air furnace. Besides the advantage of automatic control there is an added advantage found to exist in electrically heated pots, and that is the life of the pots. In the electrically heated bath where the heating elements entirely surround it, the crucible is heated more evenly and with less strain than in the fuel fired bath where the flame impinges directly on the crucible. What is said of the lead bath is also true of electrically heated salt baths and cyanide pots. One of this type of bath is shown in Fig. 4.

With the development of the art of heat-treating steel more and more attention is being given to the tempering operation after hardening. The drawing specifications for a given kind of steel for a given application are almost as rigid as the hardening requirements. This, of course, means accurate control of the drawing temperature. To cope with this situation the electrical engineer has brought out the electrically heated drawing furnace, including the electric lead drawing pot above mentioned, the electric oil pot, and the air drawing furnace. Oil is usually used for lower temperatures or for less severe draws than lead. The film of oil which is left on the work after it has been treated in an oil bath is sometimes undesirable, in which case an air furnace may be used. In all three classes of furnace the aim of the designer has been to assure close regulation and uniformity of temperature to the user.

The widespread use in the machine shop of low melting metals such as solders, babbitts, type metals, lead and zinc, whose melting points fall below 900 deg. F., has brought on the market a line of electrically heated equipment to meet the conditions under which these metals are used. These conditions vary from the small soldering iron consuming a few pounds of solder a day up to the equipment for melting and pouring several tons of metal daily.

The utility of an electric soldering iron is based on its convenience. No heating stoves are required; there are no escaping fumes; no delays in waiting for the iron to re-heat; and furthermore, since the heat is generated within the iron, it is thermally more efficient than the fuel heated iron. In melting solders or babbitts in quantity, as for bearings, the control of the pouring temperature is important, because it has an effect on the quality of the work. The workman will turn out more and better work if the question of temperature control is taken out of his hands and regulated by a mechanical device of known precision. With the fuel fired pot an operator must spend much time adjusting the burners. The construction of the solder pots is similar to that of the high temperature lead pots, and the many advantages of one apply to the other.

In the average shop there are a large number of miscellaneous applications for heat which are often not given enough consideration as heating problems. These operations include such processes as the baking and drying of japan and paint, heating of liquids, driving off moisture, baking armatures, drying lumber, core baking, heating presses and platens, protecting sprinkler systems, and small steam generation requirements. While some of these operations are of major importance in certain industries, they are considered incidental in others, and come within this discussion.

For such processes as baking and drying the standard

Fig. 8—A small labor saver

This 30-lb. electric solder pot can be placed near the work, thus saving time and affording better working conditions.

industrial electric oven, such as illustrated in Fig. 5, will meet most of the requirements. These ovens are being manufactured in many sizes, and their design is aimed to insure adequate ventilation and uniform heat distribution. Convenience of charging and discharging should be taken into consideration in making a selection, and the oven should be heat insulated in proportion to the temperature of the process. To meet conditions which do not warrant the initial investment for a new and complete outfit, there have been developed types of unit electric heaters which, being self contained, are of great assistance in working out these miscellaneous processes.

The space heater consists of a heating element encased in a sheet metal sheath approximately 1½ in. wide, ⅛ in. thick, and varying from 12 to 54 in. in length, depending upon its capacity. It is good for operating temperatures up to 500 deg. F., and may be installed readily in home-made ovens, around water tanks, or on presses. One of these heaters is shown in Fig. 6. The unit oven heater, Fig. 7, is designed for installation in industrial ovens for temperatures up to 800 deg. F. The heating element is a ribbon wound over two parallel rods held by end frames, the heating element thus forming a flattened spiral. For heating liquids directly by immersing the heating unit in the liquid the so-called immersion heater has many advantages. It may be inserted directly into a tank or it can be secured with a sheath with the liquid circulating through it.

A Practical Construction

The medium-temperature heater, for operation up to 1,200 deg. F., consists of an assembled block of refractory porcelain, 26 in. x 9 in. x 1¾ in., in which are a number of parallel grooves through which is threaded a spirally wound heating element of wire. This same type is built also as a flexible unit so that it may be strapped on cylindrical surfaces. For temperatures up to 1,800 deg. F., a self-contained unit known as the high temperature heater finds much use when installed in furnaces already constructed. The heating element is made up of large heating wire, Number 1, 2 or 3, bent into a flattened spiral shape 3¼ in. thick, 7 to 12 in. wide, and 26 in. long. The ends of the loops are supported in refractory porcelains, these being held by a cast frame of heat resisting metal. With this rugged type of construction it may be hung on furnace walls, on roofs, or laid flat on the floor. All of these unit heaters are constructed for operation on the customary shop voltages, either in series or parallel combinations, and they may be used with automatic control apparatus.

In choosing control equipment the user should be guided mainly by the nature of the process and the heating equipment used. Relatively low temperature operations up to 900 deg. F. may be controlled by the contact making thermometer, or thermostat. This scheme makes use of the thermometer principle. The expansion and contraction of some medium such as mercury or nitrogen gas from the variations in temperature actuates a small electrical contact which, by means of appropriate relays, opens or closes the main contacts on the heating elements. For higher temperatures the pyrometer is best adapted. This depends upon the principle of the thermocouple, or the difference of potential between the ends of two dissimilar wires joined together at their ends when one of these ends is exposed to a higher temperature than the other. The difference of potential, or voltage, is proportional to the difference in temperature between the two ends of the wires. The variations in this voltage due to variations in temperature is reflected on a sensitive voltmeter on which is arranged a high and low contact. When the temperature is high or low the contact will close or open the main heater contacts.

In deciding whether or not a particular process should be electrified it is generally understood that the installation must be economically justified. Such a decision should be based on a thorough study taking into account all factors. Although in many cases electric power may be more costly than other fuels, there are a number of features such as convenience, better product, and less spoilage, that more than over-balance the higher cost of electricity. The conclusion, therefore, would be that before making a new heating application or changing an old one a log of all factors entering into the case, both for and against, should be made, starting with initial costs through to the last detail. From this log an unbiased balance may be taken upon which the final decision should be based.

"Put It In My Envelope"

By Charles S. Kinnison

I wanta tell yuh somethin', Boss,
And that is—Can your apple sauce!
This welfare stuff has had its day—
I'm *sick* of it—I'm here to say!
I'm man enough to git along
Somehow, without your dance and song.
So I don't need your custard soap
I want it in my ENVELOPE!

My words may seem a little rough,
But I am SICK of all this guff.
You MEAN all right—so please don't think
I'm callin' you a crazy gink.
I understand it's hard for you
To git us fellows' point of view—
For, don't you see, your life and ours
Is far apart as weeds and flowers!

I don't blame you, for what I am,
And wealthy guys I do not damn—
Your job LOOKS soft to me—but still
I reckon it is hard to fill.
You have your fight, the same as me,
But, SAY! I wish that you could see
The way to fill our hearts with hope
Is—put it in our ENVELOPE!

I want no more than I am WORTH
While I am here upon this earth.
But if you'd show that you're a friend,
And have some cash you want to spend—
Don't spend it on our swimmin' pool;
Or hifalutin language school,
Or on a lot of useless dope—
But PUT IT IN OUR ENVELOPE!

Clock-punchers almost invariably work by the clock, which is as it should be in the shop, where, between whistles, a man is expected to be off the job. Clock-punching doesn't pan out so well with the brain worker, who is likely to resent the implied call-down when he faces the clock on the morning after a night of work at home.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Spring Guard on a Drill Spindle

BY CHESTER H. FRANKLIN

The accompanying illustrations show an unusual form of guard on a drilling spindle that was recently seen on an Avey machine. A volute spring (that is a cross between a spiral and a helical spring) is fastened to the collar of the counterweight arm and to the flange

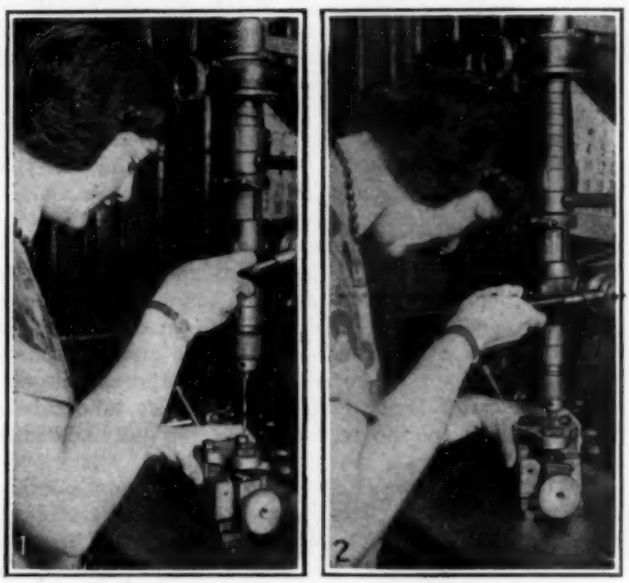


Fig. 1—Guard spring closed. Fig. 2—Extended and preventing contact with spindle

under the top bearing, so that it remains stationary while the spindle revolves. Fig. 1 shows it compressed when the spindle is raised, while in Fig. 2 it is extended when the drill is in its lower position.

In leaning over, as in Fig. 2, the operator's head comes very close to the spindle but the spring protects her hair, keeping it away from the revolving spindle.

How Would You Do This Job?—Discussion

BY S. A. ROBBINS

On page 904, Vol. 63, of the *American Machinist*, Henry Densmore presents a problem in the shape of a steel tube, or shell, with a wall 0.087 in. thick, in which is to be punched a hole that is very nearly as large in size as the internal diameter of the shell.

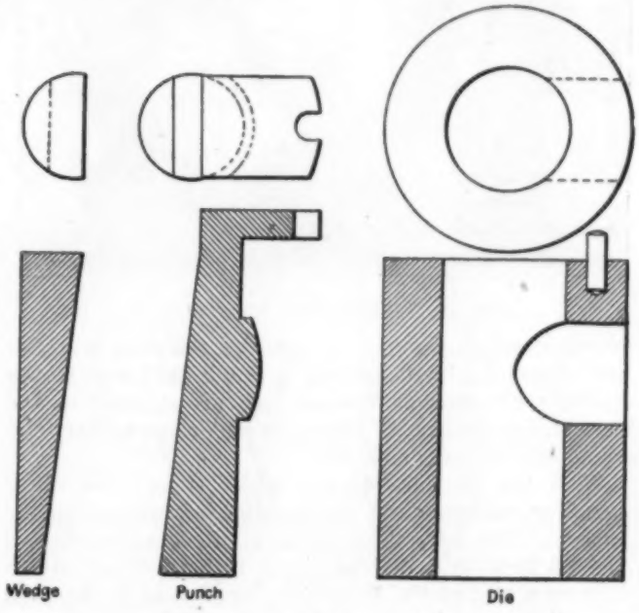
Obviously, the job could not be done on a horn die, for the hole in such a die would almost cut the die in two, leaving but about $\frac{1}{64}$ in. of metal on each side. Though I have never had occasion to do work of this kind where the cross-hole was so large in proportion to the size of the shell, nor upon metal so thick as Mr. Densmore cites, I am of the opinion that it could be done by piercing from the inside outward.

I would make my die in the form of a bushing with a cross-hole in the side, as it is to be in the shell. The internal diameter of the bushing should be such that the shell would slip into it comfortably, but not have much shake. A stop at the bottom of the die would locate the shell endwise so that the hole would be pierced in the right place.

I would then make a round plug of a diameter to fill the shell, and on one side of the plug I would make a round projection of the right size to pierce the hole in the wall. The projection would extend from the side of the plug just far enough (0.087 in.) to pass through the wall of the shell, but no more.

I would then put this plug in a shaper vise and plane away one-half of it, as I have tried to show in the sketch, so that it would present a flat surface on the side opposite to the projection, which flat side would be at an angle with the axis of the plug; in other words, a wedge of half-round section.

I would then make another plug exactly like the first, except that it would have no projection on the side, so that when the two tapered pieces were placed with their



Tools to pierce hole in side of shell

flat sides together I would have a full round plug with the projection on one side to pierce the hole in the shell.

I would set my bushing die into a suitable die-bed, the latter having a clearance hole in the side through which the punchings could pass out, and set it up under a press with a flat pusher tool in the ram.

With a shell in the die, I would first set the wedge-shaped punch into the hole in the shell by hand, so that the projection was opposite the hole in the die. Next I would put the plain wedge in its proper place to fill the bore of the shell, except that it would not go all the way down because of the projection on one side of the piece already in there.

When the ram of the press comes down, the second wedge will be driven clear to the bottom, so that the two wedge-shaped pieces will now completely fill the shell. If the projection on the first wedge was placed opposite to the hole in the die it would most certainly punch a corresponding hole in the wall of the shell.

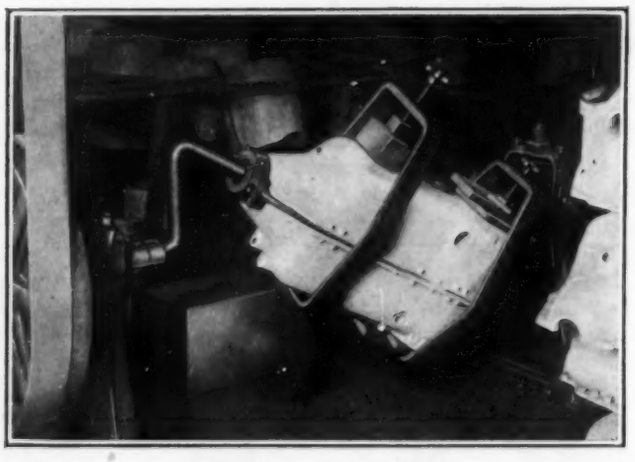
It would probably be necessary to make a large head on the first wedge, or punch, with a keyslot in it to fit over a substantial pin in the die so that the projection could be lined up with the hole in the die with certainty, for there would surely be fireworks if it wasn't.

A Wabble Rumbler

BY FRANK C. HUDSON

Even the tumbling or cleaning room of the foundry offers more opportunities for ingenuity than one might imagine. For the thorough cleaning of castings is important in many cases.

The illustration shows a rather unusual method of rattling the oil pans of airplane engines in the foundry of the Wright Aeronautical Co. The apparatus consists



A rumbler that wabbles

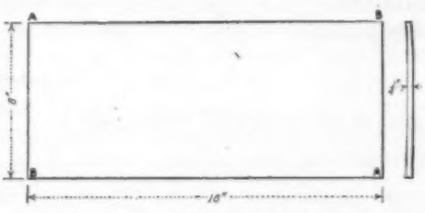
of two shafting hangers, mounted on the floor in an inverted position, and carrying a crankshaft bent to the special angle shown. Two oil pans are clamped on the shaft using collars at the ends and clamps that surround the two pans as shown.

With the oil pans loaded with "stars" and other rumbling material, the whole thing is revolved by the pulley at the left. The angle of the crankshaft tips the old pans to a decided angle in both directions as they revolve, and the stars slide lengthwise in the pans as well as travel around the inner surfaces. Similar methods can be used to advantage in other work.

Straightening Cold-Rolled Plates

BY H. R. FOWLER

"What is the best way to straighten, or make flat, a rolled steel plate?" That is the question we have asked everybody we are acquainted with, whom we thought ought to know; blacksmiths, sheet metal workers, toolmakers, etc., and there seems to be a surprising lack of knowledge on the subject. At least it was surprising to us, for we never thought it was much of a job until we tried straightening some flat-rolled plates ¼ in. thick, 8 in. wide, and 18 in. long. The more we would hit the high side, or the low side, or the corners of the plate, the worse it seemed to get. We annealed the plates, thinking to take out the strains—that helped some. We tried putting a heavy maple plank under the plate, on the theory that there would be less rebound under the hammer blow than there would be from the surface plate, thereby helping the metal to "stay put." The ordinary bend was not so bad, but when the corners were like the sketch, with *A-A*, resting on the surface plate and corners *B-B*, sprung up ⅛ in., it changed the problem considerably.



The plate to be straightened

We managed, after an uncomfortable amount of time had been spent on the job, to get them fairly flat, but nothing to boast of. Does anybody know what actually happens to a piece of steel under these conditions of straightening? Does the "skin" stretch or is the hammer blow simply a means of disturbing the adjustment of the molecules of the metal, so that they take a new position, more in line with what we would like them to take.

In straightening a shaft between centers on a lathe, the usual procedure is to apply a lever to the high side of the shaft as it runs out, then spring it some indefinite amount, or as much as seems safe, and then have someone hit it a "wallop" with a hammer on what was the low side. Sometimes the shaft will come straight under this treatment, but it is an open question how long it will stay that way. A round- or flat-peen hammer, is probably as good as anything to be had for rough straightening, or where the surface is to be machined afterwards, but in our case hammer marks on the plates would have been objectionable, since the stock was practically finished size. We had to do most of the straightening with a blacksmith's "flatter" and a sledge hammer.

If, instead of a blow with a hammer, pressure is applied only to the high side of a bent piece, it is necessary to go to or beyond (I'm not sure which) the elastic limit of the material. All we know is, that we have to spring the piece further than the point we are aiming for, and hope that on the rebound it will stop where we want it to. That may be a rather crude way to describe something which has been the experience of most of us, but the method of straightening is crude enough to make it excusable for most anything being said about it.

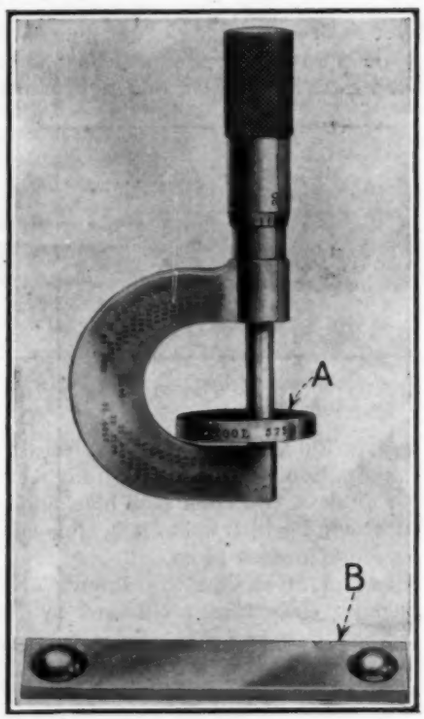
We will be glad if someone will tell us the proper way to do such a job.

Lapping Micrometers

By H. L. Van Keuren

With the proper tools it is easy to recondition a micrometer and put it in better shape than when new. Like an automobile, a micrometer if kept in condition is a better mechanism when it has been used for some time than when it comes from the factory. Daily use tends to wear in the screw, which is the heart of the micrometer, removing uneven spots, making a better fit, and reducing errors arising from irregular threads.

The operations required to put a micrometer in condition are as follows: Adjust the nut to take up any backlash that may be present in the screw; lap the measuring surfaces flat and parallel; set the micrometer to a correct zero reading; and record the errors at 1 in., and at several intermediate points. The backlash, or looseness of the screw, must be taken up before any lapping is done on the measuring surfaces, because a wabbly spindle will cause rounded edges on the measuring surfaces when the lapping is done. The laps required are flat disks, having the two opposing surfaces flat and parallel to within 0.00001 in. Machine-steel disks 1¼ in. in diameter, and ⅛ or ¼ in. thick, have been found suitable for this work. The lapping surfaces of the disks should not have grooves or scores, since these marks collect coarse abrasive. A smooth lap is easily cleaned, and can be used either for rough or finish lapping.



Micrometer lap and ball tester

The lap is inserted in the micrometer as at *A* in the illustration, and the spindle is screwed down with slightly more than the ordinary measuring pressure. If the micrometer has a spindle lock this is set, otherwise the spindle is held stationary with the fingers. The lap is then moved between the measuring faces, giving it a back and forth circular motion. It is better to pull the lap rather than push it, to prevent rounding the edges on the measuring surfaces. Use all portions of the lap in order to secure even lap-wear. A few strokes of a dry lap will polish the high spots of the measuring surfaces, and indicate at once just how much the surfaces are worn.

The lapping may now proceed, first with a lap ⅛ in. thick, and then with one ¼ in. thick. The object of using laps of two thicknesses, is to secure measuring surfaces that are at right angles with the axis of the spindle. The micrometer surfaces may be lapped with one lap, say the ¼-in. size, so that the surfaces are parallel, but at an angle to the axis of the spindle, at readings of zero, 0.025, 0.050, and all like positions of the spindle, including the 0.250-in. reading. But if the spindle is moved a half turn, as at 0.0125 in., 0.0375 in., and like positions, including 0.1875 in., further lapping with the ⅛-in. lap will correct this condition.

Rough lapping does not mean using a coarse abrasive, since the surfaces to be lapped are of small area, and are usually only one or two ten-thousandths of an inch out of true. A fine flour of emery, aloxite, alundum, or the equivalent, may be used with kerosene as a lapping medium. Usually one or two dozen strokes of each lap for rough lapping will be found sufficient.

For finish lapping, the laps may be wiped clean and used dry. If a high mirror finish is desired, the very finest lapping powder obtainable may be applied to the laps with alcohol. The laps are used until the alcohol has evaporated, and the final finishing is then done with a dry lap.

Lapping may be accomplished by holding the micrometer in the right hand, as is done in measuring work, and manipulating the lap with the left hand. The writer has found it convenient to hold the micrometer in a vise, holding the spindle stationary with the left hand, and moving the lap with the right hand. Care must be taken not to distort the micrometer frame, as in so doing the measuring faces will be lapped parallel when out of their true alignment. If the micrometer is held at the outside of the frame, between leather and vise jaws, there is little danger of distorting it.

The flatness of the anvil and spindle can best be tested with an optical flat, which will show light-wave interference bands; or, better still, with an optical parallel, which will test both flat and parallel correctness to units of millionths of an inch. If an optical flat or parallel are not available, a good idea of the perfection of the measuring faces may be obtained with the ball tester shown at *B*. The ball tester has a ⅛ in., and a ¼ in. steel ball. On inserting either ball between the faces of the micrometer, the same feel should be obtained anywhere between the faces. An error as small as 0.00001 in. can be detected with the ball tester, and by feeling around with the tester it may be found that the faces are high in the center and low on the edges, or that they are not parallel.

After an inspection for accuracy of faces, the micrometer should be set to correct zero reading and tested with gage blocks. For this purpose a set of combination gages of 0.0625, 0.125, 0.250, 0.500, and 1.000 in. is recommended.

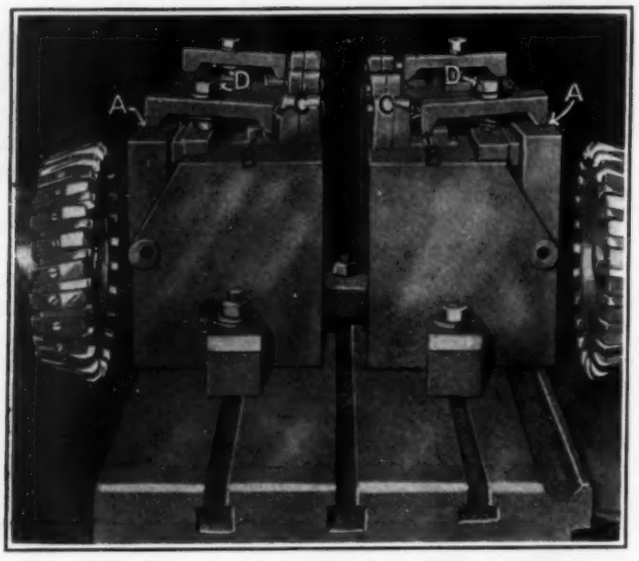
If the foregoing suggestions are followed, a micrometer can be reconditioned in 15 min. No difficulty should be encountered in securing mirror-like surfaces on the measuring faces, or in securing a degree of accuracy of one hundred-thousandth of an inch.

Clamps That Draw the Work

By I. B. Rich

It frequently happens that we want to use a clamp that will tend to draw the work against the bedding points in a fixture. One method of doing this is shown herewith, from the shop of the Rickenbacker Motor Company.

The outer ends or clamping surface of the clamps are



A clamp that draws the work against the fixture

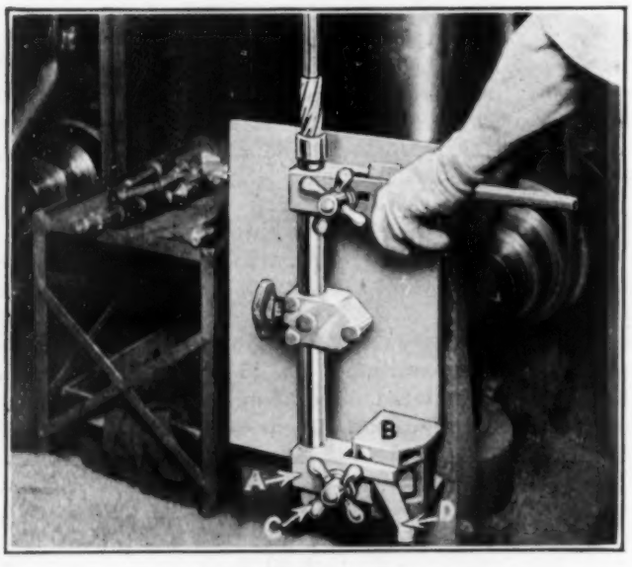
serrated at *A*, while the back ends rest on the inclined surfaces, as at *B*. The inner ends of the clamps back up against plugs, as at *C*. Drawing down on the bolts *D*, forces the inner end of the clamp down the inclines and draws the work against the face of the fixture.

Quick-Operating Jig Clamps

By Henry C. Francis

A good example of quick-acting jig clamps was recently found in the Toledo, Ohio, shops of the Willys-Overland Co. and is illustrated herewith. Each clamp as at *A*, fits loosely between the sides of the blocks *B* and is roughly adjusted to the work by means of the cross-handled nut *C*.

At the back of each clamp is a lever *D*, having a cam on its inner end. After the nut *C* has been adjusted



A quick-acting jig clamp

to bring the clamp to approximately the correct position, the cam on lever *D* makes the final clamping quick and easy. The job is boring the ends of the intake manifold of Overland-six, the hole being bored with the core drill shown.

Simple Milling Fixture for Round Work

By John Strama

The milling fixture of simple design shown in Figs. 1 and 2, was designed for milling the slot in the plunger shown in Fig. 3. The work was to be done in large lots, the material being 1-in. round, cold-rolled steel. The slots are ¼ in. wide and ⅛ in. deep.

Since the diameter of the material varied about 0.001 in., clamps, screws or other adjustable parts would ordinarily be necessary to the proper holding of the work, which would make the tool complicated, expensive, and slower in operation, while the fixture here described can be handled quite rapidly.

The construction of the tool will be understood upon referring to Fig. 2. The member *A* is secured by fillister-head screws and dowel pins to the shoe or base *B*, while the member *C* is attached to *A*, by six hexagon-head machine screws, and is provided with 20 holes to

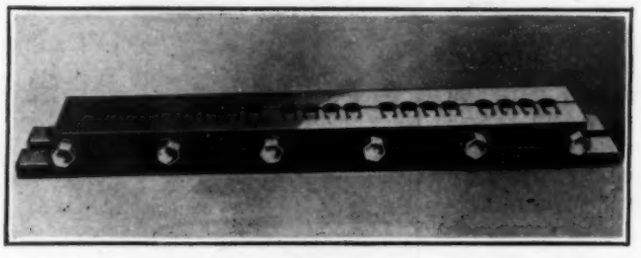


Fig. 1—The fixture

receive the same amount of pieces to be slotted. Upon examination it will be seen that member *C* has a number of slots, two from each hole, and running toward the outer edge, which make it flexible enough to apply equal pressure to each piece.

In operation, the six screws are loosened and the member *C* is forced outward by the pressure of the springs *D* opening the holes to receive the cold-rolled pieces. After the holes have been filled, the six screws

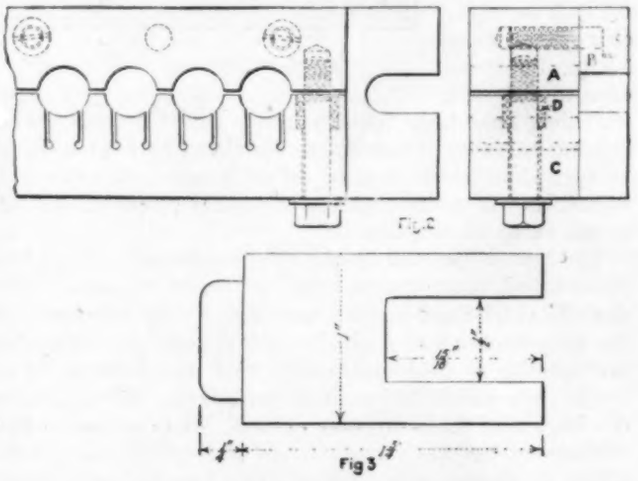


Fig. 2—Construction of the fixture. Fig. 3—The work to be milled

are tightened by a socket wrench. A cover plate or light gage (not shown) and having 20 holes, is placed over the pieces to keep out the chips. The milling cutter is of high-speed steel and the maximum speed and feed are applied.

Properties of Alloy Steels

An alloy is a solidified solution of two or more metallic substances. Alloy steels are steels containing one or more metals in addition to the iron, and sometimes one or more non-metallic elements other than carbon. These elements give to the steel certain distinctive properties. The metals may be either mechanically mixed, or in chemical combination.

An alloy may have a greater or a lesser density than the mean of its constituent metals, but is always harder than the hardest of its constituents. As a rule an alloy is not as malleable as the pure metals contained in it. In all cases the total shrinkage is less than that of the component metals. The metals commonly employed in making alloy steels are: manganese, nickel, chromium, vanadium, tungsten, molybdenum, cobalt, uranium, and silver.

Manganese Steel—This alloy contains from 6 to 20 per cent, usually about 14 per cent, of manganese with less than 1.5 per cent of carbon. Manganese is a very brittle metal, and the resulting alloy with steel is extremely hard, strong, and tough, offering a high resistance to wear. Manganese steel is usually cast to form, but it can be forged at a yellow heat. It is difficult to machine, but can be partly softened by quenching from about 1830 deg. F. The hardness is restored by heating to about 1380 deg. F., and cooling slowly in the air. Manganese steel is used for rails, frogs, crossings, lips and teeth of dredge buckets, jaws of crushing machinery, car wheels and tires, and armor.

Nickel Steel—Nickel steel ordinarily contains from 2.75 to 4.5 per cent of nickel, and from 0.20 to 0.40 per cent of carbon. Nickel raises the elastic limit and tensile strength of steel, lowers the critical point, and increases the toughness. Nickel steel resists corrosion better than ordinary steel, and this property increases with the nickel content. Nickel steels are made with elastic limits up to 120,000 lb. per sq.in. It is used for guns, armor plate, structural steel, axles, shafts, crankpins, and similar parts.

Chrome Steel—This alloy usually contains from 1.0 to 2.5 per cent of chromium, with from 0.8 to 2.0 per cent of carbon. Chromium increases the elastic limit, the ultimate strength, and the hardness. Up to 1 per cent of chromium has little effect on steel, but with 1 per cent of carbon and 2 per cent of chromium great toughness is attained. Low-carbon chrome steels can be forged with as high as 12 per cent of chromium present, but the alloy becomes brittle as the carbon increases. The steel is exceedingly hard when quenched in water. Chrome steel is used for armor piercing shells, locomotive springs, axles, cutlery, files, and tools requiring great hardness. The so-called non-corroding steels derive their resistant property from the addition of about 15 per cent of chromium.

Vanadium Steel—Vanadium is a hard white metal used as a purifying, or deoxidizing, agent in making steel for a great variety of purposes. When a small percentage of vanadium is combined with chromium and manganese in steel the resulting alloy has a very high tensile strength and elastic limit. Vanadium alloy steels are employed for crankshafts, propeller shafts, axles, locomotive frames, armor, guns, and machine parts. Vanadium is used in steel either alone, with nickel, or with chromium. It makes nickel steel more homogeneous, and decreases the fragility. It is seldom used with more than 8 per cent of nickel. The addition of from 0.15 to 0.25 per cent of vanadium to chrome-steel counterbalances the extreme hardness of the chromium and produces an alloy more capable of being machined.

Tungsten Steel—Tungsten melts with great difficulty, but readily unites with steel. It is a heavy, hard metal and its effect is to make the alloy steel intensely hard and brittle. Tungsten steel is difficult to forge, and cannot be welded when the tungsten exceeds 2 per cent. When the tungsten content is high, the alloy can be worked only with great difficulty. Tungsten steel is worked at a red heat, but it is usually cast in the form of tools, and ground to the desired form. The addition of tungsten to steel produces a close and uniform structure. Tools made from the alloy can be ground to a fine edge and will not become dull when the tool becomes red hot. High-carbon tungsten steel retains a high magnetism, and is used for making permanent magnets. Self-hardening steels are alloys with from 5 to 8 per cent of tungsten.

Molybdenum Steel—Molybdenum is a silver white ductile metal, and its effect on steel is between that of tungsten and chromium. The addition of molybdenum to chrome-steel improves the physical qualities as a forging steel.

High-Speed Steels—An unlimited number of combinations of steel alloys can be made by adding one or more of the above metals to steel. Much experimenting has been done with these alloys, and the field is being continually developed. The so-called "high-speed" steels derive their properties from selected combinations of several metals. Tools made from these steel alloys can be ground to a fine edge, are capable of taking deep, fast cuts, and may heat to a dull red under the cut without being dulled.

Cobalt, uranium, titanium, and silver are also used in "high-speed" and special tool-steels in addition to the above metals. Other properties are also obtained by adding one or more non-metallic elements such as silicon, phosphorus, and sulphur. Silicon increases the hardness and ultimate strength of steel. Sulphur decreases the ductility of steel, and if used in amounts much above 0.06 per cent causes "red shortness," or brittleness at red heat. Phosphorus increases the strength of steel, but in quantities in excess of 0.07 per cent makes the steel very brittle and incapable of resisting shocks or blows. A typical high-speed steel analysis is as follows: Iron, 68.79 per cent, carbon 0.51, manganese 0.26, silicon, 0.14, phosphorus 0.02, sulphur 0.04, chromium 7.08, tungsten 22.68, and molybdenum 0.48 per cent.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Using Scrap in the Cupola

Q. We have an opportunity to buy regular quantities of scrap iron, and are considering using it in our cupola. What would you consider a fair proportion to use with commercial pig iron?

A. The proportion will depend partly on the quality of the scrap iron, and partly on the quality of castings you wish to obtain. In ordinary practice we would set 30 per cent as a maximum, but if the scrap is miscellaneous iron that may have been remelted many times, or chilled wheels, you would probably find that you could not obtain the desired results without cutting much below that amount.

In any case, do not use the scrap as it comes, but select a proportion of each variety for mixing, so that all of your runs will be approximately alike. You might try 15 or 20 per cent of average selected scrap as a mixture with your pig iron, and after testing your castings, build the proportion up gradually.

Basis for Fitting Parts

Q. In the matter of a working or free fit of circular parts, will you please advise if it is correct to make the male part to the standard size, with the female part made to suit, or should the reverse be the correct procedure.

A. The A.S.M.E. Standards' Committee bases its allowances on the proper, or standard, size of the hole. the hole is first made to the proper size, taking into consideration any determined tolerances, and the plug is then fitted to the hole, using the "fit" allowance.

Loss of Air Pressure

Q. We have been experiencing difficulty from too great a drop in pressure in our compressed air system. We have underground piping bringing the compressed air to our machine shop, a distance of about 500 ft. from the compressor. We are losing as much as 20 lb. from an initial pressure of 75 lb. per square inch. What is your advice in the matter?

A. There may be several reasons for such an excessive drop in pressure. Your transmission pipe may be too small, or it may be that you are not cooling the air sufficiently before sending it through the system. But, lacking details, we are more inclined to think that if your compressor and transmission pipes were installed according to original specifications, you have probably placed too great a load on the compressor by adding air tools or furnaces. If this is the case it will be necessary for you to put in a compressor of greater capacity, or else install an auxiliary compressor to take part of the load. We advise checking the total air consumption of the air tools on the system against the rated capacitv.

Returning Tools to the Storeroom—Discussion

BY R. B. WILLIS

I was interested in the answer to the question on page 802, Vol. 64, of the *American Machinist*, on how to get employees to return tools to the storeroom. It is a good answer, and all it said is true. It is, then, in a spirit of fellowship that I venture a sort of warning that troubles do not disappear with the establishment of a checking system and a locked toolcrib.

Many shops doing both job and manufacturing work would find six checks not enough for each workman. Ten checks for each, and possibly twenty for some of the leading workmen, will save trips to the tool room, and justify investment in enough more small tools to give out.

Never to permit workmen to enter a toolroom is right in theory. Yet this rule will sometimes be broken if it will save a workman's time to grind a cutter, for instance, rather than to wait until the attendant can get time for it between calls to the window.

The numbered check shows where the tool went, but doesn't show who borrowed it from the first man, nor who else borrowed it from the borrower, nor where it now lies, forgotten.

This brings us to the question of responsibility for tools while out on check. If we find it inexpedient to charge in money for lost tools, we may decide about how much time we are willing to have the workmen spend in hunting for them. Not much seems left to us except the gesture of charging up the lost tool as a demerit against the workman. This will worry him a lot, perhaps.

The fact is that in many shops a man has to spend much of his time just watching tools, unless he could get them all into his pockets. It ought to be safe to lay down a drill and a tap wrench, but it is not. No one intends to steal the tools, but the effect is much the same.

We shall be disappointed if we expect the toolroom attendant to spot every damaged tool as it is returned to the crib. The costly micrometer may be seriously damaged in ways that the attendant cannot take time to discover, especially when other men are waiting for tools. Then there is the man who thinks a tool becomes his personal property if the attendant cannot find his check, and the man who thinks that the attendant is to blame if he goes ahead drilling ⅜ holes without knowing or caring after asking for a ⅜ drill.

The last requirement, a capable man to run the tool crib, is perhaps the hardest to fulfill. A man who can do the job well and will stay on the job is something rare. He takes more abuse than a baseball umpire, if only because he puts in more hours per day. Let's not forget to pay him well enough to keep him, even up to the machinist's rate.

Technical Abstracts

The Arc-welding Load

In general, the conception of arc welding as a load is formed in terms of the current and voltage at the arc that is causing the welding to take place. These range from 100 to 800 amperes, and from 20 to 40 volts, and are supplied to the arc from some direct-current source, usually a special welding motor-generator set.

Obviously the load factor will tend to have a more beneficial effect on the power factor of the welding load when multiple-operator sets are used than when a larger number of single-operator sets of equivalent total output are in operation. Welding loads are inherently of a fluctuating character. At best the load imposed by one welding arc is suddenly applied and as suddenly removed. However, the maximum variation is ordinarily so small compared to the total load on a feeder that its effect is negligible. In case that a number of welders are at work either with single- or multiple-operator machines, the diversity factor can be depended upon to spread the peaks into a comparatively uniform load.

The rapid development and increasing use of automatic welding machines has brought about a greater demand for large sets of the multiple-operator type that may be driven either by induction motors or synchronous motors. W. L. Warner in the *General Electric Review*, May, 1926.

Rust Prevention

H. L. Meurer discusses the painting, sherardizing, galvanizing, etc., of steel objects and shows, partly on the basis of American investigations, that all these methods of protection are very imperfect. In fact, it appears that almost every one of them involves certain peculiarities which a while after the application may cause accelerated rusting. The one form of rust protection that the writer thoroughly approves of is a sprayed-on zinc coat followed by a coat of paint. The spraying should be preceded by sand blasting. He shows by diagrams and microphotograps that in the case of this combination the porosity of the zinc coat provokes an inter-lacing of zinc and paint layer to such an extent that even the inevitable fine cracks of the paint layer will hardly be able to expose the iron or steel to attack.—*Zeitschrift des Vereines Deutscher Ingenieure*, April 3, p. 461.

Individual or Group Drive

Dr.-Eng. H.v Neuenkirchen publishes a most comprehensive study of group drive versus individual drive. In general, his summaries convey the impression that individual drive is always economically superior. The degree of superiority, however, depends on the machine utilization, the loads on the individual machines, the size of the group and the power of the machines. Also the gain passes through maxima and minima. There appears, for instance, to be a certain medium range of power and group size where the gain is greater than with extremes in any one direction.—*Maschinenbau*, April 1, p. 300.

Grinding Locomotive Parts

Locomotive repairing is becoming more and more standardized. By proper departmentalization, worn or defective material may be handled by a reclaiming department, and the actual reconstruction of the locomotive may then take place with standardized parts. Illustrating this method of procedure is that of guide bars. For the rebuilt locomotive the units are either made up new from the forgings, or are ground down to size from larger worn out bars.

Generally speaking, grinding operations have been slowly adopted in railroad repair shops. Next to the grinding of guide bars the grinding of worn parts of the valve gear mechanism probably constitutes the more frequent abrasive operation. In some locomotive repair shops regrinding cylinders is common practice. Another form of grinding tool found in many departments is the pneumatic hand portable grinder which is used frequently for taking off the sharp edges of the main rods. Herbert R. Simonds in *Abrasive Industry*, May, 1926, p. 138.

Co-Partnership

The first principle of "co-partnership" is as old as human nature. It is that the normal average man will work harder and better for himself than he will for any master. Give a man a sense of proprietorship, or part ownership in the business in which his days are spent and he will view his working hours in quite a different spirit than that crystallized in the phrase "that he has no intention of sweating himself to make the boss a millionaire." It gratifies his spark of ambition if he can see a direct reward for his efforts.

It is a common complaint that industry is looked upon today too exclusively as a business proposition; as an affair of dividends and not as a human concern in which the well-being and happiness of all engaged in it are the constant thought of those who have control. British industry is already far too heavily handicapped in any new scheme which, whatever advantages it may hold out to one section of those engaged in industry, is not actively creative of economic wealth. If an advantage in the distribution of the national dividend is pushed too far, it may re-act on the production by injuring the efficiency of some one or more of the parties engaged as agents in that process. Industry can be crippled for example, by labor demanding from it a higher return than the industry can stand. In the co-partnership plan the employee must be given a reward outside and in addition to the standard rate of wages in his trade. To get better results, it is necessary to carry the scheme a step further and to provide that some part of the bonus shall be paid, not in cash, but in some form of claim upon the business and its assets. The best form is that a proportion of the bonus, usually one-half, shall be distributed in the form of ordinary shares in the business itself, ranking with the original shares issued to the public and carrying like rights. Colonel J. H. Boraston in *Journal of the Royal Society of Arts* (England), April 30, p. 562.

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Editors

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Internal Standards

HOW far will a standard get if the "Big Boss" does not interest himself in seeing that it is adopted and developed? The answer, of course, is "not very far." This was the big point made by James E. Gleason in his paper on Internal Standards before the National Machine Tool Builders' Association. It is a point that has been rather generally overlooked or ignored by the engineering societies and explains why so much of their extremely valuable standards work has been wasted. For a standard that is never used is not worth the paper on which it is printed.

The machine tool field is a particularly fertile one for the kind of standardization advocated by Mr. Gleason, where the men with the authority sit down around a table and decide what shall be done after their engineers have made the necessary preliminary technical analysis. Why not begin, as Mr. Gleason suggested, with a standard list of speeds for single-pulley-drive machines instead of the almost infinite variety now in vogue? The trend to individual motor drive for machine tools is strongly developed. If a range of standard speeds could be adopted, standard motor sizes and standard gear reductions would be possible and the price advantage to machine tool builders would be immediate and appreciable.

The trouble is that most companies have never really studied the standards problem and the results possible in the way of reduced costs. If the head of the company is doubtful of the value of general standards let him start in on his own outfit giving his engineers free rein to do the kind of work done at such plants as the General Motors plants, the General Electric plants, the Gleason Works, the Morgan Construction Co. and others. When he has given that phase of the standards movement a fair chance he will surely be ready to get together with other manufacturers on general standards.

Wages

THAT wages should not be cut except as a last resort is the principle announced by American business as its reply to the statement of policy made by the American Federation of Labor at its last conference. At least, this principle was put forward in an address before the Department of Manufacture meeting of the Chamber of Commerce of the United States and it met with hearty indorsement, in the discussion that followed, by industrial leaders from all parts of the country.

It is not to be expected that all employers will adopt the principle at once although the most progressive ones have realized its validity for some time. There are reactionary employers just as there are reactionaries in the ranks of labor who are still convinced of the soundness of the old doctrine that limitation of individual output makes jobs for more men and hence a living for all. The labor leaders will have their hands full in trying to line up some of the unions that still adhere to the European idea.

Nevertheless, it is an encouraging evidence of the consciously co-operative spirit remarked by Secretary Hoover that business leaders publicly acclaim the principle that prosperity and high wages go hand in hand, and that labor leaders abandon the output limitation theory.

High wages, on which prosperity can be based, imply increased production on the part of the worker—in other words, payment on results rather than on time put in. For, to maintain a prosperous condition a business, a community or a nation must produce more than it consumes. And, too, the worker of today must be provided with machinery that will enable him to multiply his own efforts by adding to them the harnessed forces of nature.

Does Copying Develop an Industry?

IMITATION may be the most sincere form of flattery, as has been said, but nothing is less conducive to friendship or peace of mind. Builders of machines are constantly finding that ideas which they believed to be original with them are being utilized in other machines. Where these machines compete for business the result does not tend to promote a kindly feeling toward the one who copies.

On the other hand some contend that this copying in any line advances the art, both by raising the general average of product and by widening the use of such devices. And in many cases it would require the wisdom of a Solomon to determine where the idea really originated.

Some builders of high class machines rely less on patents to protect against being copied than on their experience in producing a higher quality of product that consistently gives excellent satisfaction. They know that in most cases other ways can be devised to accomplish the same results and that the genius of good design is not confined to any one man or shop. With this in mind some look at the copying and adopting of ideas as a part of the natural development of any industry and refuse to become unduly excited over it.

Shop Equipment News

Warner & Swasey Universal Turret Lathe, Heavy-Duty, No. 3-A

A heavy-duty universal turret lathe, with 7½-in. bar capacity, and incorporating several improvements, has been brought out by the Warner & Swasey Co., Cleveland, Ohio. The machine is designed for great driving power, sturdy feeds, and high rigidity. In addition, the design includes a protection of the ways from grit and cutting lubricant. By means of this protection, the alignment of the ways, an indispensable feature for accurate work, is maintained in harmony with the performance of the other machine members.

The heavy-duty machine, No. 3-A, is shown in Fig. 1, and a detail of the head in Fig. 2. It is universal for either bar or chucking work, but the bar capacity and the swing have both been materially increased. For bar work the capacity through the chuck is for 7½-in. round bars, with a turning length up to 39 in. The maximum swing over the ways for chucking work is 25¼ in., and the square turret carriage clears a diameter of 18 in. The hexagon turret carriage has a longitudinal movement of 48 in., while the square turret has a cross travel of 12¾ in. All of the advantages claimed for the smaller capacity 3-A turret lathes are retained in the heavy-duty 3-A. The design permits the taking of combined cuts from the hexagon and square turret at the same time.

The way-covers completely inclose the ways of the bed. The ways of the machine are always covered, regardless of the simultaneous operation of the hexagon turret and the square turret in different positions along the bed. This improvement is considered to be of great importance because with it the ways maintain the original accuracy of the machine for a long period of time. Grit, chips, and cutting lubricant are prevented from reaching the surface of the ways, and the wear from the continual dropping of chuck wrenches or other tools is avoided.

The construction of the way-covers is shown in the illustration, Fig. 3. The pressed steel main top cover *A* runs the entire length of the ways, passing through an inverted V-slot in the square turret carriage. The main top cover is fastened to the hexagon turret saddle, thus moving independently of the square turret carriage.

The left, or free, end of the main top cover is supported by the main cover support *B*, a heavy cast iron member attached to the square turret carriage and moving with it.

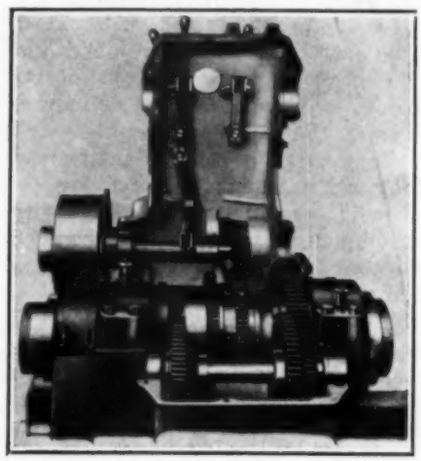

Fig. 2—Details of the head

This support provides solid metal between the main top cover and the ways, so that heavy chucks can be mounted, or heavy work gripped, without damaging the way-covers. In order to prevent chips from work-

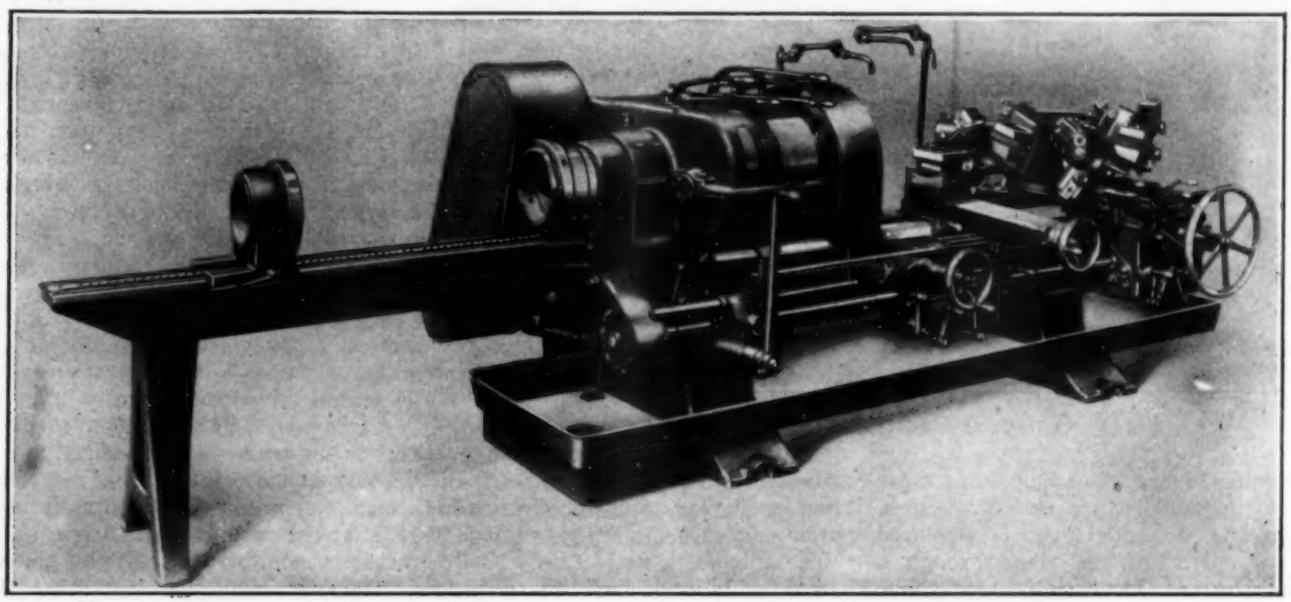

Fig. 1—Warner & Swasey Universal Turret Lathe, Heavy-Duty, No. 3-A

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ing up underneath of the main top cover in the space between the hexagon turret saddle and the side carriage, a lower way guard, *C*, is provided. This guard is attached to the right side of the square turret carriage, moving with it and passing into a slot in the hexagon turret saddle.

The rear way at the back of the machine is protected by a heavy rolled cover that rests directly on the ways, and passes through a tunnel at the back of the all-geared head. Two shorter covers are also added at the back of the hexagon turret saddle to prevent chips from dropping off the tools onto the rear ways.

To provide a reliable method of lubrication when the ways are inclosed, the square turret is fitted with an oil plunger pump that can be filled with an ordinary oil can. Oil is then fed with pressure to the ways.

To provide accurate alignment for heavy duty work, the turret is clamped to its seat by means of a patented binding mechanism. This mechanism has a split ring with a double taper, which hugs the taper on the saddle and turret, respectively. A single lever is employed for operating the ring through a right- and left-hand thread, thus tightly binding the two members together.

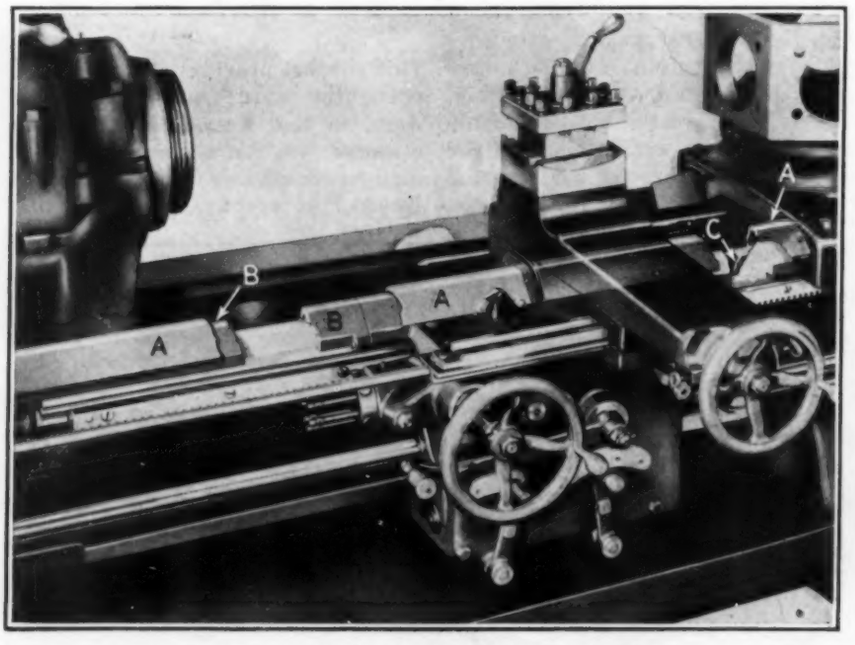

Fig. 3—Warner & Swasey Turret Lathe Way-Covers

Another important feature claimed for the machine is the wide range of feeds and speeds. The hexagon turret is equipped with sixteen feeds, either forward or reverse, eight of which are obtained by levers conveniently located in the turret apron. An additional lever operates a doubling gear located in the gear box at the head end of the machine, thus giving a range of feeds of from 0.005 in. to 0.167 in. per rev. of the spindle to suit any diameter within the capacity of the machine. The square turret provides sixteen longitudinal and sixteen cross feeds for the carriage. These may be operated either forward or reverse.

The machine has sixteen spindle speeds readily controlled by levers on the head. The all-geared head is designed to give ample power through a series of broad-faced alloy-steel gears. These gears run in oil, while flood lubrication is provided for the entire head. The front and back shafts, and also the drive shaft, run on taper roller bearings with adjustment for end play. This feature makes possible a narrow head in front and rear, and increases the power efficiency.

The spindle is made from a solid hammered billet of special hard steel. The spindle nose is threaded for fastening the chuck securely to the spindle, but the pilot is tapered instead of being straight, giving greater rigidity and permitting redressing of the taper in case of wear. Starting, stopping, and reversing the machine are done by means of a duplex clutch placed on the back-shaft, having bronze and steel friction members.

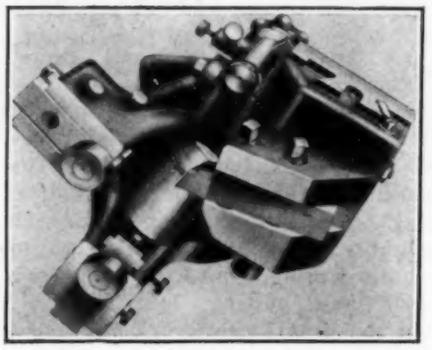

Fig. 4—Warner & Swasey Universal Turning Tool

The bed of the machine is designed to absorb the maximum torque of the head, giving great rigidity without unnecessary bulk. The head is cast solid with the bed. The square turret carriage is anchored to a third rail at the lower front of the bed, so that the cross-slide does not have to reach across the ways for rigid anchoring. This arrangement permits the spindle and turrets to be brought close to the bed without cutting down the swing. The carriage of the square turret is mounted on the front "V," and is gibbed to a lower bearing on the front of the bed.

A power actuated rapid traverse is provided for moving the turret to and from its working position. This power traverse can be arrested at any point. At the end of the return stroke the power feed is automatically disengaged. The turret feed is engaged by levers in the saddle apron. The feeds are automatically disengaged by adjustable stops on the roll. These stops can be set quickly within accurate limits.

A geared oil pump is coupled direct to the traverse drive shaft, and delivers the coolant at the rate of six gal. per min. When the machine is supplied with motor drive the motor is mounted on a vertical plate at the rear head-end leg, making a compact mounting.

The tool equipment supplied for

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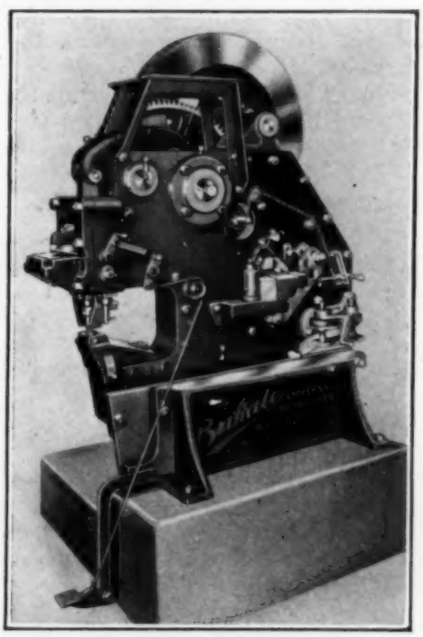
either chucking or bar work is designed with the idea of rigidity and convenience. The standard bar equipment consists of a 22-in. three-jaw scroll chuck, a ratchet bar-feed with work support, two universal turners, a chamfering tool, a short and a long flanged toolholder, and a 3-in. automatic opening diehead. An idea of the construction of the tool equipment is obtained from the illustration, Fig. 4. In the design of the tools attention has been given to the prevention of interference between the hexagon turret tools and the square turret tools, thus giving full advantage of the capacity of the machine for combined and multiple cuts.

Buffalo Universal Iron Workers With Built-In Copers

The Nos. ½ and 1½ universal iron workers, manufactured by the Buffalo Forge Co., 448 Broadway, Buffalo, N. Y., and one of which has been previously described on page



Buffalo Universal Iron Workers With Built-in Coper

442, Vol. 61, of the *American Machinist* are being supplied with built-in copers, as illustrated. The universal iron worker is one of the "armor-plate" line made by the company.

The coper will work on angles, I-beams, T's, channels, Z's, plates and flats, as well as other rolled shapes. The machine itself is also supplied with the regular punch, shear and bar cutter. The coper is built on the punch end of the machine, as shown in the illustration, and is operated by the same controls, either hand or foot, as the punch. The pedal control permits the use of both hands for manipulating the work. The built-in coper makes it unnecessary to interchange the coping tools with the standard punching tools, as required with the ordinary coping attachment. A sheet-steel cover guard, not shown in the illustration, is provided to fit over the coper in order to protect the worker.

The No. ½ coper will handle 5-in. channels, 6-in. beams, and angles 3x3x$\frac{7}{16}$-in. The coper for the No. 1½ machine will take 6-in. channels, 7-in. beams and 3x3x$\frac{3}{8}$-in. angles. It is claimed that only one cut is required for full depth on all sections.

The built-in coper cannot be supplied for machines previously manufactured since the design of the punching head has been changed.

Millers Falls Electric Drill

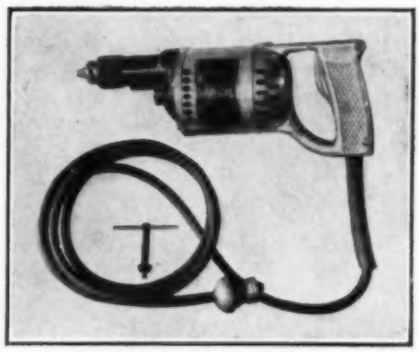
The Millers Falls Co., Millers Falls, Mass., has brought out an electric drill for universal service where a light and compact tool is required to drill holes up to ¼ in. in diam. in metal. Larger sizes are in process of development.

The body of the tool is of aluminum. The motor is universal, and runs on either direct or alternating current, the latter of any frequency up to 60 cycles. Motors are furnished for 110 or 220 volt circuits. The armature shaft runs upon ball bearings and the drill spindle is fitted with a ball thrust bearing. Grease lubrication is provided for all bearings and for the heat-treated, alloy steel gears.

A special Cutler-Hammer switch in the pistol grip is actuated by a trigger that is held down by the finger of the operator while the tool is in service. When it is laid down the motor stops automatically.

A feature of this drill is in the mounting of the pig-tail brushes from the outside of the housing. By withdrawing two screws, the brushes may be removed for inspection or renewal without disturbing any electrical connections.

The tool is furnished with a Jacobs chuck to hold drills up to ¼ in. in diam. The drill spindle is offset so



The Millers Falls electric drill

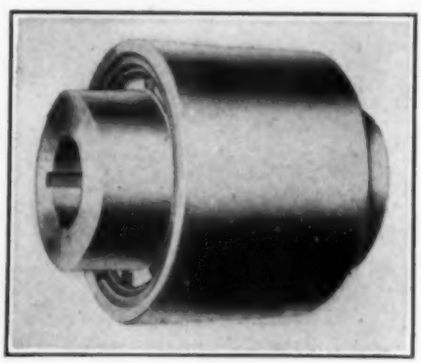
that holes may be drilled to within ⅛ in. of a parallel obstruction.

Eight feet of rubber covered cord and an armored attachment plug are furnished with each tool. The weight is 5 lb. The length is 12 inches.

Clark Flexible Coupling

The flexible coupling shown in the accompanying illustration has been placed on the market by the Clark Controller Co., Cleveland, Ohio. It is intended for application to any direct-connected load including fractional horsepower drives as well as heavy-duty requirements.

The couplings consist essentially of three pieces: a sleeve and two



Clark Flexible Coupling

abutting hubs. The hubs each have four teeth on their circumference and the sleeve which extends over the two hubs has four teeth facing inward to mesh with the teeth of the hubs. Eight packing strips of

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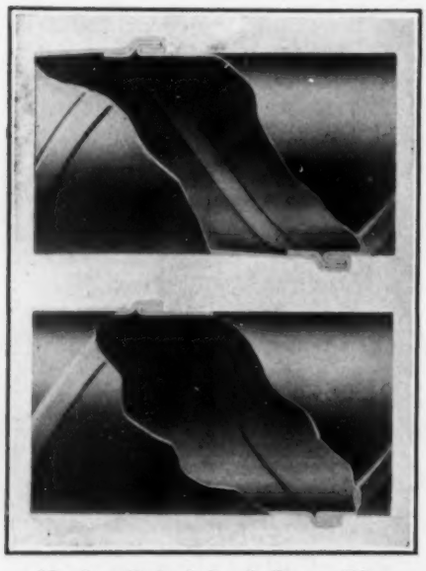
the hydraulic type are inserted between the teeth of the sleeve and the hub so as to provide a cushioning effect. The sleeve is held over the hubs by means of keeper and spring retaining rings.

The couplings are made in eleven sizes with bores from ⅜ to 6 in. in diam. for a maximum horsepower service, at 100 r.p.m., of from ¼ to 100. The two smaller sizes are made from bronze but the others can be had in either cast iron or cast steel.

Naylor Spiral Lock-Seam Pipe

The spiral lock-seam pipe illustrated is manufactured by the Naylor Spiral Pipe Co., 1230 East 92d St., Chicago, Ill. A strip of sheet steel is wound into a spiral shape, but instead of riveting, the edges are automatically flanged into a 4-ply lock-seam laid up on the outside of the pipe so as to permit the free and easy flow of material in conveying. The upper of the two sections shows the pipe with a high-carbon steel wearing strip for handling abrasive materials. The lower type is for water, air, gas and non-abrasives.

The pipe is formed in a continuous piece and then cut in the desired



Naylor Spiral Lock-Seam Pipe

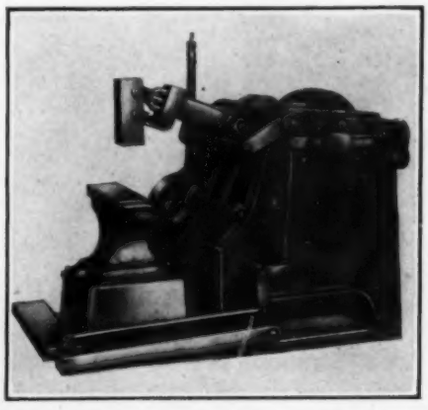
sections up to 40 ft. in length. It is made from No. 16 to No. 10 gage sheets and from 4 to 30 in. in diam. Plain, galvanized, painted and asphalted pipe may be had.

Chambersburg Smithing Hammer

The Chambersburg Engineering Co., Chambersburg, Pa., has placed on the market the smithing hammer shown in the accompanying illustration for service in forge and repair shops, as an auxiliary to hand forging operations.

The intensity of the blow can be regulated from a light tap to heavy forging blows. The head of the hammer is mounted so that its face is always parallel to the anvil. The same pedal controlling the blow also controls a power traverse for moving the hammer so that it can strike on any part of the surface of the anvil.

The machine can be operated from



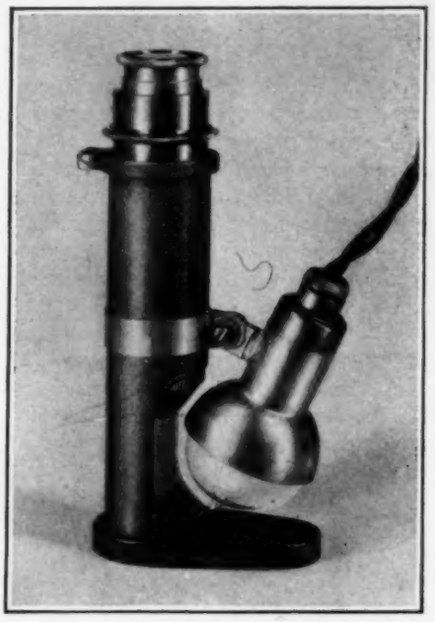
Chambersburg Smithing Hammer

a belt or an individual 2½-hp. motor mounted on the machine frame. It will make a maximum of 218 blows per minute. The weight of the hammer head is 50 pounds.

Pittsburgh Illuminated Brinell Microscope

The Pittsburgh Instrument & Machine Co., 1026 Reedsdale St., N. S., Pittsburgh, Pa., is marketing an illuminated microscope, illustrated, for measuring the diameter of impressions made by Brinnell machines.

The microscope is mounted in a vertical tube that is supported by a circular base. The aperture in the base for viewing the specimen is 10 mm. in diam. The interior of the body tube surrounding the aperture is finished in white to increase the illumination of the specimen. An illuminating lamp is supported from



Pittsburgh Illuminated Brinell Microscope

a bracket clamped to the tube and the light is directed to the specimen and shielded from the observer by means of a reflector.

The focusing tube carries a Ramsden eyepiece and a 32 mm. achromatic objective. The tube slides in the body and is clamped by means of a ring and screw. A 7-mm. micrometer disk graduated in tenths of a millimeter is provided and the eyepiece is focused on this disk.

Thompson Radius Grinding Attachment

The Thompson Grinder Co., Springfield, Ohio, is marketing a radius grinding attachment for its 10x36-in. universal grinding machine. The purpose of the tool is for sharpening the faces, sides and corner radii of channeling milling cutters such as are used by railroad shops for work on side rods. It can also be used for grinding radii on other cutters, including end mills. The capacity for milling cutters ranges from 3¼ to 10 in. in diameter.

The cutter is mounted on an arbor that has a longitudinal movement in a bracket by means of a sliding block controlled by a screw. The bracket in turn pivots about a stud shank, mounted in a housing, so that any angle of clearance may be obtained. The housing itself slides in dove-

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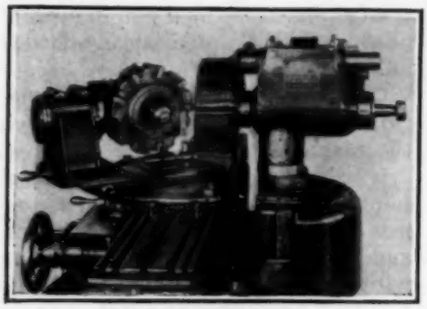


Thompson Radius Grinding Attachment

tailed guides in a plate and its movement is controlled by a screw and crank. The plate is pivoted to the center of a semicircular sub-plate and swings in a horizontal plane for 180 deg. The sub-plate is bolted rigidly to the main table of the grinder by means of T-head bolts.

Small end mills can be ground by removing the bracket with its round shank and inserting in its place an arbor having a taper hole in its end into which the shank of the end mill is inserted.

The sliding movements are graduated in thousandths of an inch, and the rotary movements, in degrees. A gage is furnished to give the required clearance angle. The device is universal and flexible.

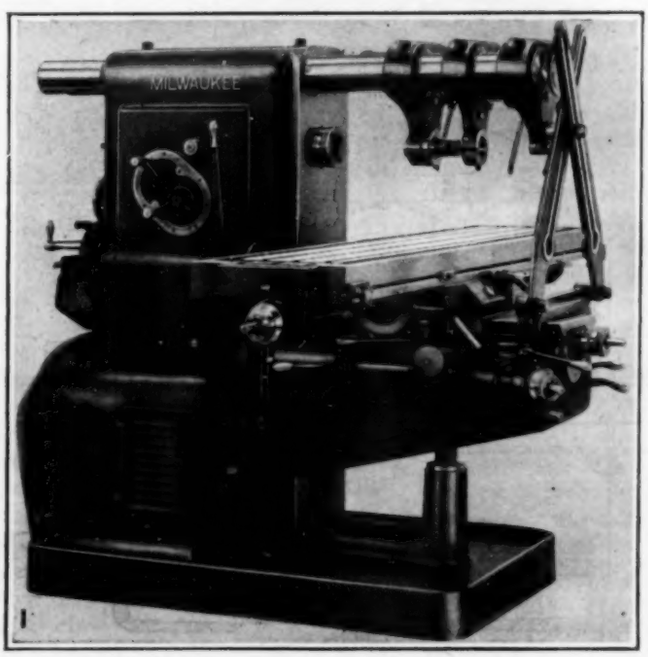
"Milwaukee" Milling Machine, No. 4B

To meet the need of a heavy-duty milling machine for use in railroad shops and in plants that handle large-sized work, the Kearney & Trecker Corporation, Milwaukee, Wis., has added to its present line a machine designated as the No. 4B, and illustrated in Figs. 1 and 2. The machine is made in three models—plain, manufacturing and vertical types—that embody many features intended to simplify operation and to offer rapidity in handling heavy work.

The column of the machine is cast integral with the base. The drive is constant and is provided with eighteen changes of speed that are secured through gearing arranged similar to that of other models. With the exception of the spindle and the three-step idler, the machine is equipped with Timken anti-friction roller bearings for the spindle drive. The bearings transmit the power developed by the motor or belt to the spindle with a minimum power loss and with a minimum generation of heat within the machine. The application of anti-friction bearings, made in accordance with the trend in machine-tool design, is intended to offer an efficient drive that is desirable on a machine of this size. In Fig. 3 is shown a cross-sectional view of the horizontal machine illustrating the arrangement of the bearings and gearing.

One outstanding feature in the machine is the power rapid traverse that is provided not only for the table but for the saddle and knee. The table travels longitudinally in either direction at the rate of 150 in. per min.; the saddle operates in or out at 70 in. per min.; and the knee up or down at the rate of 50 in. per min. Power rapid traverse has been included in all directions so the machine can be set up and operated with ease, especially when raising the table carrying a heavy work piece. All power rapid-traverse movements are conveniently controlled from the front.

The clutch for engaging the power rapid traverse, Fig. 4, is of the multiple-disk type identical in construction to the main-drive clutch located within the column, the only difference being that it is smaller in size. At *A*, in Fig. 2, is shown the lever for controlling the clutch that is located on the right-hand side of the rear of the knee. The clutch is accessible through a cover plate in the same method as the main-drive



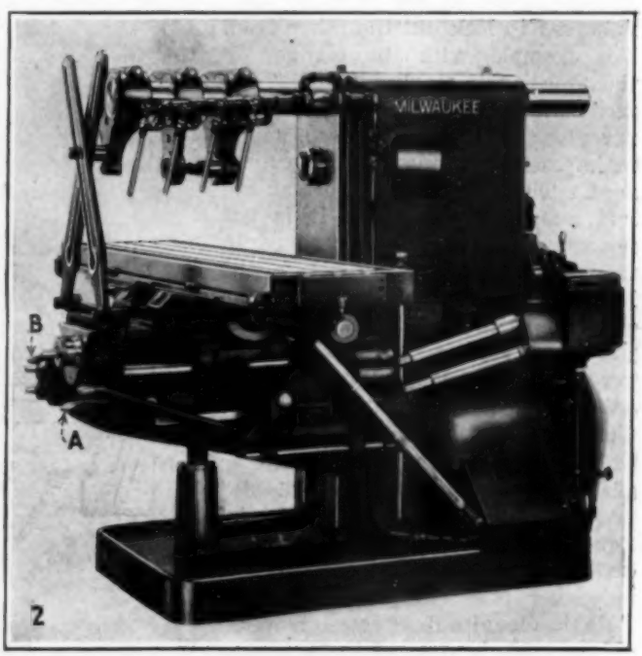


Fig. 1—"Milwaukee" Milling Machine, No. 4B. Fig. 2—View showing opposite side of the machine

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clutch. Adjustments are made in a similar manner.

The friction clutch for the main drive is controlled by the lever next to the power rapid-traverse lever in the front of the machine. An additional lever working in conjunction with it is provided at the left-hand side of the column. It is for the same purpose, but enables the operator to control the clutch from a position at the rear of the table when working in that location. The power longitudinal feed is controlled by a lever located in the center of the saddle. The feed is independent of either the cross or vertical feeds and may be engaged or disengaged while either of the other feeds are in operation. A lever working in conjunction with this control, located under the table on the left-hand side of the machine, is provided also.

Lever *B* is used to start, stop and reverse the cross or vertical power feed which is selected previously by the feed-selector plunger. An arrangement similar to the other levers is provided so its operation can be controlled from the rear.

The feed-selector plunger engages in three holes in the pad on the front of the knee. The upper hole is marked "cross" and the power hole is marked "vertical." When the plunger is set in one of these holes it serves to lock out the other feed. For example, with the plunger in the upper hole marked "cross," the feed-control lever starts, stops and reverses the power cross feed, and it is impossible to engage the vertical feed. There is a third hole at the left marked "table," but it is not necessary for the plunger to be in this hole in order to operate the longitudinal power table feed. The power longitudinal table-feed lever, previously explained, starts, stops or reverses the longitudinal power table feed independently of either the cross or vertical feed.

The feed-selector plunger must be placed in the hole marked "table" in order to obtain the full 150 in. per min. rapid traverse in the longitudinal direction. If the plunger is in either the "cross" or "vertical" hole, the longitudinal power traverse to the table is reduced to 70 in. per minute.

The feed plate, attached to the end of the feed box, is located at the left-hand side of the column. The plate indicates the feed in inches per minute, according to the positions of the upper and lower feed-change levers and the feed-change knob. The three positions for both the upper and lower feed-change levers are marked on top of the feed box with the letters, *A*, *B*, and *C*. To obtain a feed change, the upper and lower levers are shifted in the desired position and the plunger knob is pulled in or out in accordance to the feed desired. These changes can be made while the machine is in operation. Speed changes, however, cannot. Eighteen feed changes, arranged to work automatically in either direction, ranging from $\frac{3}{4}$ to 25 in. per min., can be obtained. The feed box is of the sliding-gear transmission type. All gears are heat-treated, hardened, and run in oil supplied by an automatically-flooded lubrication system.

On the right-hand side of the machine, a safety clutch is provided on the rear end of the upper universal drive shaft in front of the universal joint. The clutch carries any normal or even excessively heavy cut, and it will slip only when meeting with positive obstruction. This feature prevents accidents or a breakdown that might occur otherwise. Two powerful coil springs are located within the clutch and purposely there is no means provided for adjusting them or to take them apart since the clutch is set correctly when mounted.

Two automatic pumps are used in connection with the machine. The pump for automatically flood-lubricating the gears and bearings inside the column feed box is located on the

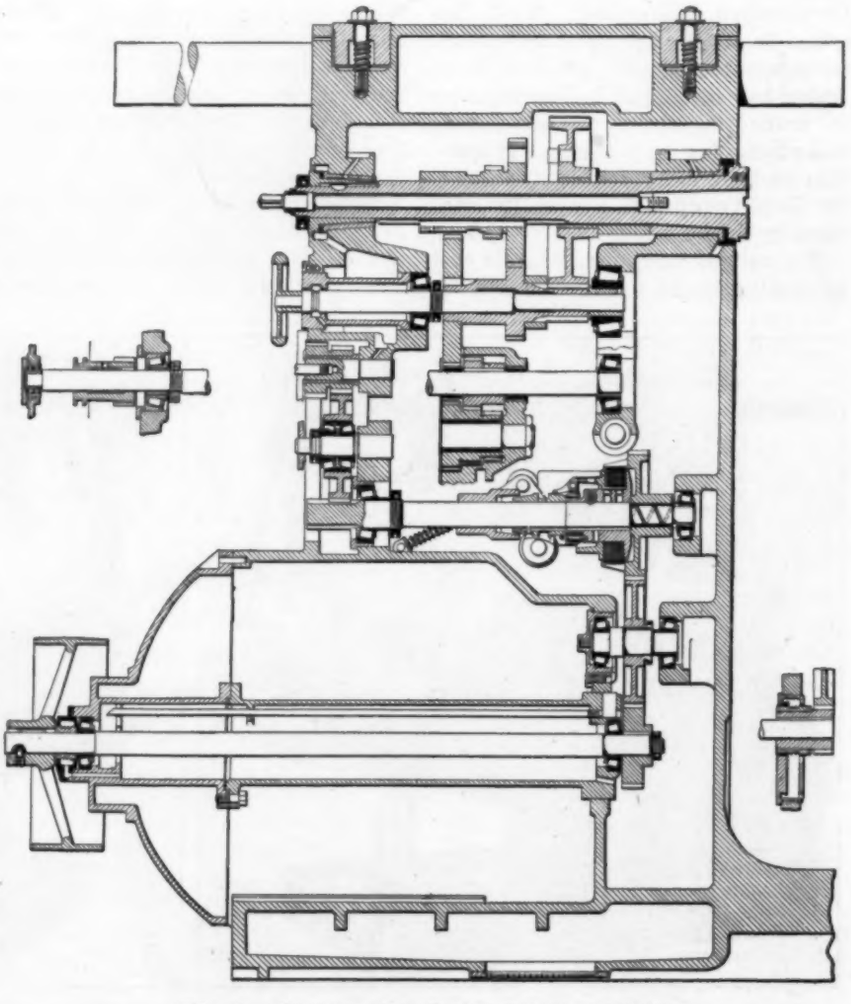

Fig. 3—Cross-sectional view of the machine

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left-hand side of the column, above the filler cap and sight level gage. To remove the pump from the machine it is necessary only to release four cover-plate screws. The cover plate, of which the pump is an integral part, contains both the intake and outlet passages for the oil. When the plate is removed, the pump is totally disconnected and there are no pipe joints to be broken. Fig. 5 shows the pump being removed.

The coolant pump is located on the right-hand side of the column to the rear of the reservoir marked "cutting compound." The pump is driven by a vertical shaft from the feed box and may be made total inoperative when milling cast iron or other metals that do not require a coolant for the cutters. The intake and outlet connections for the pump are similar to the lubricant pump previously described. Both the coolant and lubricant pumps have the advantage of being within the machine, completely covered and out of

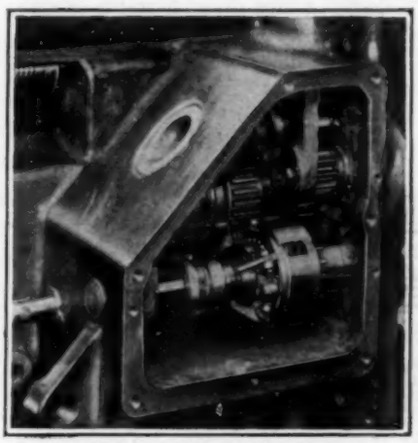

Fig. 4—Power rapid-traverse friction clutch

the way, yet accessible for replacement when necessary.

Approximately 80 per cent of the lubrication of the machine is concentrated at three centralized filling points, including the automatically-flooded lubrication, the splash lubrication with filling plugs, sight-level gage and drain plug that is provided for all the rapidly moving parts in the rear of the knee, and the wick feed oiling of the table and saddle. Two oil-well pockets on either side of the table-feed control lever at the top of the saddle and an oil hole in the center of the front edge of the table are provided. There are wicks running from these oil pockets to the various moving parts of the table and saddle and also to the flat bearing surfaces where the table bears

Fig. 5—Method of removing pump

against the saddle and where the saddle bears against the knee. There are a few other oiling pockets besides these mentioned that are indicated by spring caps and pocket covers.

The universal joints for driving the main feed shaft and the power rapid-traverse shaft are of the self-oiling type. The joints are connected in a ring consisting of an inner bronze driving ring and an outer steel shell. The ring is larger in diameter than the universal-joint shaft. This construction increases the resistance of the joint against torsion and provides a powerful drive. Oiling is provided to the joints through an oil passage drilled in the body of the joint that leads through the pin into the oil groove on the inside of the steel ring. Pockets within the feed box and the splash lubricant chamber in the knee provide a flow of oil leading from either end of the joint shaft. The oil enters the joint fork, after which it is carried to the ring by centrifugal force and thus keeps the connecting pins properly lubricated. The self-oiling universal joint is somewhat of a departure from the usual type of joint.

The motor pinion, idler gear and the gear on the friction clutch are provided with ground teeth. They are the only ground gears in the machine and constitute the first three fast moving gears in the spindle-gear train.

The working surface of the table is 19x76 in., but a standard long table, giving an increased longitudinal feed of 52 in., can be provided. The table is machined all over and has two front and two rear return pockets for the coolant that have been added in addition to the two usual oil pockets at either end. The pockets are covered with metal screens and steel plates. The long steel strip that is used on smaller machines to cover the channel at the rear of the table has been replaced by a cast-iron partition built integral with the table.

The machine is designed primarily for motor drive, although provision is made for a belt drive. The same column is used in either case and to change from motor to belt drive it is necessary only to remove the rear door of the motor compartment and bolt in its place a bracket sleeve and pulley. The change can be made at any time throughout the life of the machine. For the standard motor drive, a motor is placed with its pinion toward the front of the machine. This arrangement provides a directly-geared drive and enables the motor pinion and idler gear to be located in the main column of the machine where they are automatically lubricated. The motor in this position gives accessibility to the brushes.

The normal range of the machine is 42x14x20 in. The weight of the machine ranges from 10,800 lb. for the plain model to 12,400 lb. for the universal model.

"Garvin" Automatic Tapping Machine, No. 2-BG, Improved

The "Garvin" automatic tapping machine, No. 2-BG, illustrated has been improved by its manufacturers, the Western Machine Tool Works, Holland, Mich. The machine is similar in design to the No. 2-X tapping machine described on page 829, Vol. 60, of the *American Machinist*, but is of larger capacity.

The increase in capacity is obtained through the use of back gearing, which is placed above the forward-driving friction pulley. The

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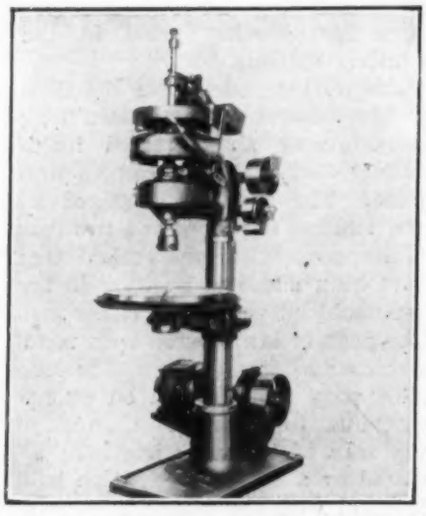


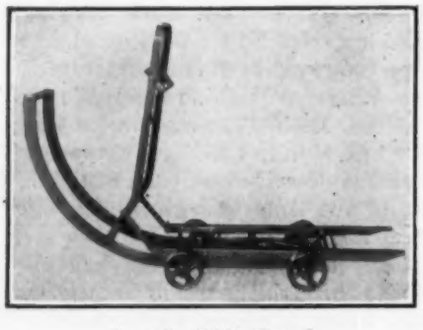
"Garvin" Automatic Tapping Machine, No. 2-BG, Improved

gearing is protected so that the operator is not endangered. Guards are also provided for both the low-speed forward drive pulley and the high-speed reverse pulley, each of which are mounted on roller bearings. The machine is driven by a 1½-hp. motor, the base of which is cast integral with the machine base. A positive-drive tap chuck is fitted to the lower end of the floating spindle. The capacity of the machine in cast iron is a 1¼-in. U. S. standard tap or a ¾-in. pipe tap. The maximum depth tapped is 2½ in. The table can be adjusted 20 in. vertically.

Arcade Lift Truck

In the accompanying illustration is shown the 1-ton lift truck which has been placed on the market by the Arcade Manufacturing Co., Freeport, Ill.

The truck consists basically of a frame in the form of an elbow which, at its lower end, carries the axles for four wheels 6 in. in diam. and 1¾ in. in width. The lifting platform is drawn upwards by means of a frame handle that is drawn back against the upper end of the elbow-shaped frame of the truck. A hydraulic release check is provided so that the load can be lowered without jar or strain on the truck or its mechanism.



Arcade Lift Truck

The length of the truck over all is 62 in. and its width is 17 in. The height of the truck when raised is 7⅝ in., and the amount of elevation is 1⅝ in. The wheel base is 19 in. long. The truck weighs 100 pounds.

"Niles" Wheel-Quartering Machine, 90-Inch

A machine for boring simultaneously crankpin holes in locomotive driving wheels is being built by Niles-Bement-Pond Co., 111 Broadway, New York, N. Y. By means of a special attachment any crankpins mounted in the wheel sets can also be turned. Fig. 1 shows the machine with the crankpin turning attachment in place, while Fig. 2 shows the boring operation. The design provides for wheel sets that have a right-hand lead only, and for this reason it is claimed that the machine can be built with greater rigidity.

The bed is 28 ft. long and 24 in. deep. It is cast of close-grained iron, and rigidity is obtained by means of a solid reinforcing web that extends across the top of the cross girts, which are spaced at frequent intervals. The machine is provided with a right and a left hand headstock. These heads are mounted and slide on large 90-deg. V-ways on the bed that keep them in perfect alignment with each other. The center-to-center distance of the ways is 48 in. The heads are adjustable laterally along the bed by power and each is held in place by means of long shoes fitted underneath the ways. They are clamped in position, both front and back, by an eccentric clamping device actuated by a wrench and can be clamped effectively from either position. The wheel sets are carried on centers set in large sliding spindles that are adjusted through a screw, which is operated by a handwheel on each side of the head. The spindles are clamped at the front by a lever. The headstocks are designed to carry the quartering saddle within the main casting. The guiding surfaces for the spindle saddles are accurately planed so that the included angle between the two spindles is 90 degrees.

A saddle carrying a spindle is mounted in each headstock and is adjustable toward and from the dead spindle centers from 11 to 20 in. This movement is equivalent to 22- to 40-in. piston strokes. Adjustment is made by hand through a screw, and to facilitate the setting to a predetermined stroke, scales are provided that give the position of the boring bar in relation to the dead, or axle, centers. The front portion of the saddle is gibbed and is held to a square-lock bearing planed on the headstock. The thrust is taken on two guides, one on either side of the spindle. This design is said to eliminate distorting strains. The boring bar is 4½ in. in diam. and is a hammered forging made from 0.45 carbon steel. It is provided with hand and power traverse for lateral movement. Each bar is supported on the outer end of the saddle and is kept in alignment by means of an outboard bearing, which also carries a nut for the feed screw. To prevent overtravel of the bar when feeding or traversing in either direction, adjustable limit switches are fitted to the saddle that automatically shut off the power from the driving motor when the bar has reached the limit of its travel. The feed mechanism for the spindle is contained in the saddle, and two feeds, $\frac{1}{32}$ and $\frac{1}{16}$ in., are provided. The feeds and fast traverse can be reversed.

The wheel set is supported from each journal by two compensating V-blocks, which are free to slide on a large elevating member, the lower end of which is threaded for the purpose of raising or lowering the V-blocks to take care of the variation in size of journals. A worm gear is used to turn the screw. The supporting bracket also carries the outboard bearing for the boring bar and scales are inset on the sliding

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surface for ease in setting the outboard bearing to correspond with setting of spindle saddle. The support brackets are adjusted laterally on the bed in or out in relation to each other by left- and right-hand screws operated through large handwheels.

The supports accommodate journals ranging from 8 to 14 in. in diam. A wing is provided on each bracket to which the wheels are clamped in position for quartering. To bring the wheels into proper location, adjustable links are provided, one in each head, that are fixed to the wheel rim at one end by means of a C-clamp and to the bed at the other by means of an eyebolt.

Each boring spindle is independently driven by its own motor through a large worm and wheel running in oil. The worm is of steel, hardened and ground, and the worm wheel is of bronze. A gear box giving two changes of speed is interposed between the motor and the boring spindle. The gears are made of heat-treated steel and run in an oil bath. Power for the traverse of each head is taken from this gear box by means of a positive clutch operated by a lever on the side of the box. All bearings are bronze bushed and all shafts and gears are liberally proportioned throughout the drive.

The machine can be furnished with either d.c. or a.c. motors. With direct current, two 5-hp. shunt-wound motors are provided with two speeds of 650 and 1,300 r.p.m. In conjunction with the gear box, these motors give boring-bar speeds of 5.7, 11.4, 11.9 and 23.8 r.p.m. Each motor is equipped with an automatic controller with push-button stations for starting, stopping and inching. A separate field rheostat is used to obtain the speed range of the motor.

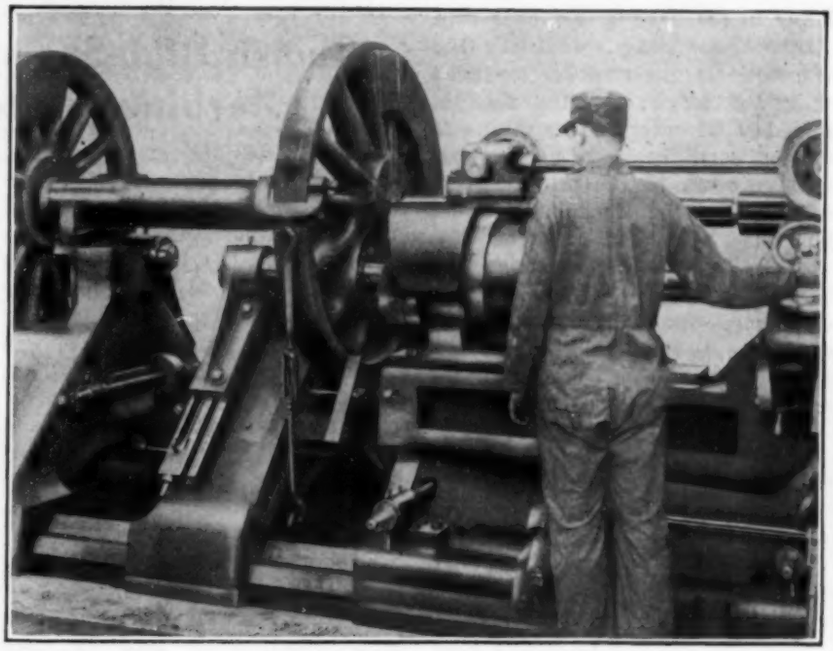

Fig. 2—Boring crankpin holes

With alternating current, two 5-hp. squirrel-cage induction motors are used. The motors operate at 1,150 r.p.m. and spindle speeds of 10 and 21 r.p.m. result through the use of the gear box. An automatic starter and compensator with starting, stopping and inching push-button stations are also provided.

Double crankpin-turning attachments of the box-tool type, can be furnished additionally. Each attachment consists of a heavy base fitted to V-ways on the bed and rigidly bolted to the planed pad on the headstock. Long shoes are fitted beneath the ways, and the base is clamped to the bed by an eccentric clamping mechanism in the same manner as the heads. A sliding bracket that carries and guides the revolving crank pin turning head is bolted at one end to the saddle and the other is supported by a bearing on the base. This sliding member is adjustable with the saddle to provide for varying crank throws. Scales are furnished to facilitate this setting. When the desired setting has been obtained, the bracket can be locked

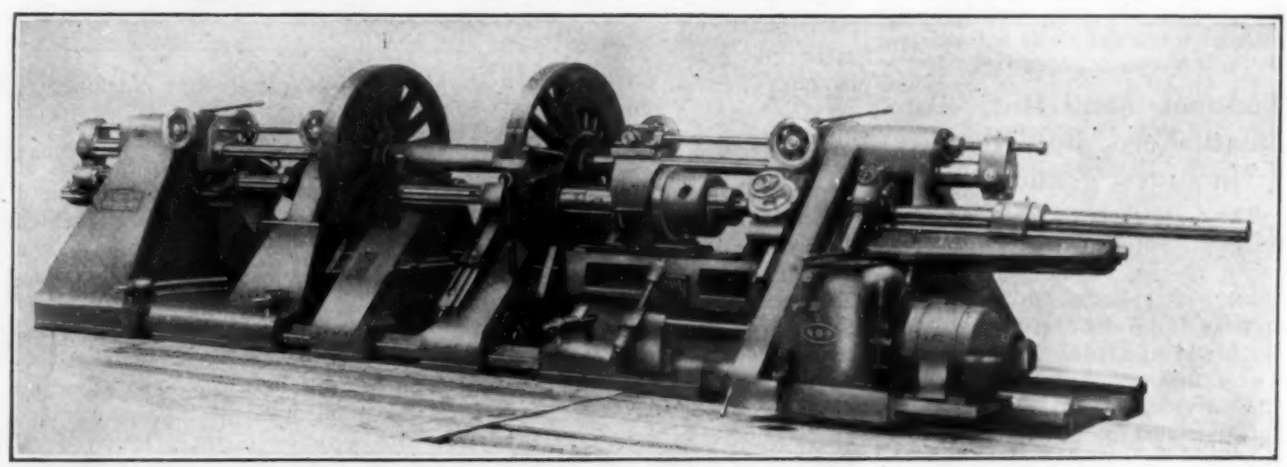

Fig. 1—"Niles" Wheel-Quartering Machine, 90-Inch, with Crankpin-Turning Attachment

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firmly to the base by a binder bolt.

Into the sliding spindle in the headstock is inserted an extended center of large diameter that is guided at its outer end by means of an outboard bearing bolted and dowelled to the base. On top of this bearing is located an additional handwheel connected with the sliding spindle screw mechanism so that the centers may be extended or withdrawn either from the setting-up position at the wheels or from the operating position at the heads. To preserve alignment a screw is coupled through bevel gears to the elevating screw in the saddle.

When setting up for crankpin turning, it is necessary to re-locate the boring bar through the sleeve of the outboard bearing on the saddles in relation to its position for quartering. Properly spaced taper pin holes in the bar corresponding with taper holes in the sleeve are furnished for this purpose. Wheels may be quartered without the necessity of removing the crank pin attachment. The end of the boring bar is arranged to receive an auxiliary bar, the outer end of which is supported by an adjustable bearing on the wheel supports. The bearing for the crankpin-turning head also acts as a support for the boring bar on the other side, assuring rigidity for the bar and boring tool. When the crankpin-turning attachment is furnished, additional start, stop and inching push button stations, one for each motor, are supplied.

Crankpins up to 12 in. in diam. and 24 in. in length may be turned. The swing over the bed is 99¾ in. The boring bar and headstock can each be traversed about 5 feet.

National Semi-Hot, Automatic-Feed, Bolt-Heading Machines, ⅜- and ⅝-Inch

The description of the ⅜- and ⅝-in. semi-hot, automatic-feed, bolt-heading machines, of the National Machinery Co., Tiffin, Ohio, published on page 841, Vol. 64, of the *American Machinist*, included a photograph, Fig. 4, that was made with the negative inverted. The shearing mechanism should be on the right-hand side.

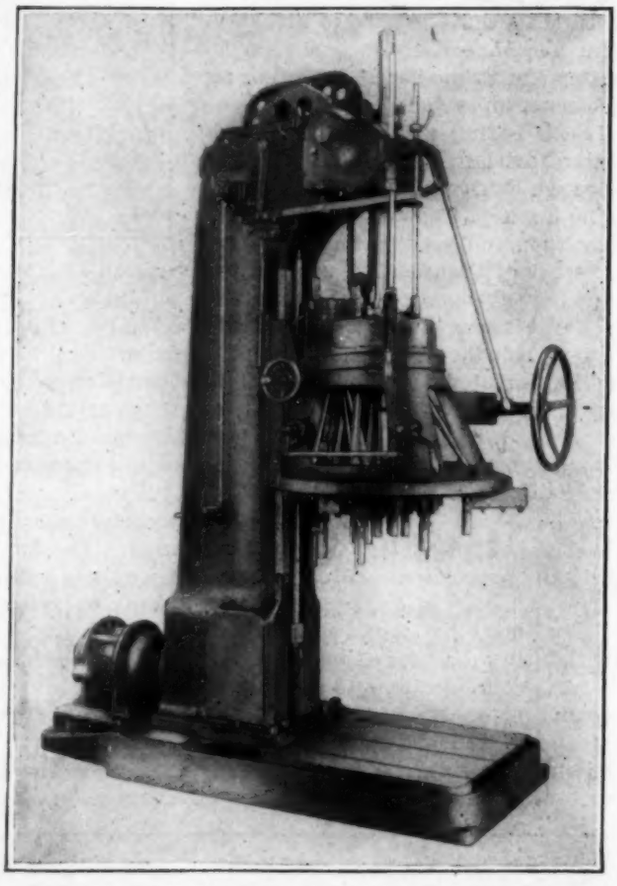
Baush High-Speed Multiple Drilling Machine, Center-Feed, No. 2A

The No. 2A high-speed multiple drilling machine shown in the accompanying illustration has been built by the Baush Machine Tool Co., Springfield, Mass. Round heads can be had 16, 20 or 24 in. in diam. for twelve or sixteen spindles in each of the sizes. The rectangular heads can be had in sizes of 16x30 or 20x40 in., for twenty-six or thirty-two spindles in each size. The maximum drilling area is the size of the head.

The machine is designed to be heavy and rigid. A feature of the machine is its center feed. The feed ram is directly over the center of the head and the drill layout in order to eliminate any tendency for the head to spring away from the guides on the upright when used under heavy loads.

The machine can be arranged for either belt or motor drive. The belt drive is from a line shaft to tight and loose pulleys mounted on the horizontal drive shaft on the bed of the machine. When a motor drive is used the motor is mounted on the bed and directly coupled to the drive shaft. The power is transmitted from the horizontal drive shaft to a vertical shaft through bevel gears. The vertical shaft drives the spindles through a three-speed gear box. The head is equipped with back gears that give a 3.1-to-1 reduction on the round-head models and a 2.6-to-1 reduction on the rectangular heads.

The drive from the horizontal shaft is directly up to the head instead of to a yoke and thence down. Excessive driving torque and friction on the driving keys is claimed to be reduced through the installation of the speed-change gears in the head so that the main shaft drives at constant speed and torque. The rapid approach and return of the head through a friction clutch in the yoke is built as an integral part of the machine to save labor on the part of the operator. The head is balanced by means of a counterweight which is adjustable. The column has a hole in the back for adding or removing small weights to precisely balance the head. The vertical adjustment of the spindles is accomplished by loosening one screw on the spindle arm. Holes can be drilled with a center distance nearly equal to the diameter or width of the arm.



Baush High-Speed Multiple Drilling Machine, Center-Feed, No. 2A

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Special geared arms can be provided when smaller center distances are required, or cluster plates can be used.

The machine is controlled from the front by means of a hand lever and handwheel. The lever, which can be seen nearest the wheel, operates a friction clutch in the yoke to secure rapid approach and return of the head. The handwheel is for close adjustment of the head by hand. The three changes of feed through sliding gears are controlled by a lever on the side of the column of the machine. The back gear lever is on the side of the spindle head. Above it, at the top of the head, is the feed trip-hand lever. An adjustable feed trip on a vertical rod is also provided. The three changes of spindle speed are secured through a small handwheel which can be seen at the side of the head.

The bed of the machine has a continuous oil groove around it with a coolant tank under the column. A pump with piping and flexible tubing can be furnished extra. A box table or rotating table of a size to suit the layout can also be furnished. The box table is regular equipment. Most of the bearings throughout the machine are ball or roller bearing.

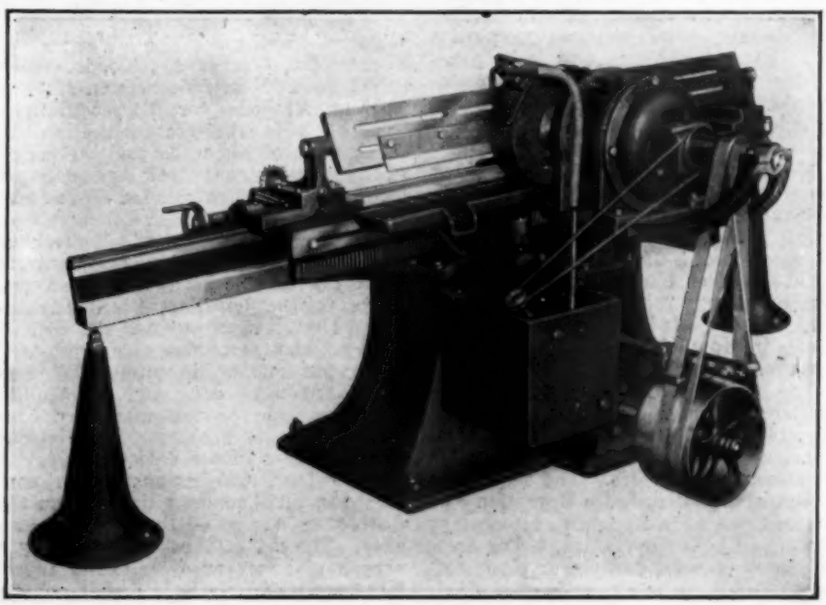
The machine can be arranged for tapping, counterboring or spot facing. The capacity of the machine is for eight 1-in. drills in cast iron, or the equivalent. The height of the machine itself is 10 ft. and 8 in., and with the ram up the height is 11 ft. and 9 in. The greatest distance from the spindles to the bed is 55 in. and the least distance is 31 in. The traverse is 24 in. The machine requires a 15-hp. motor operating at 1,200 r.p.m. The floor space occupied is 7½ ft. in length and 4 ft. and 10 in. in width. The weight of the machine is about 9,000 pounds.

"Rogers-Buffalo" Improved Knife Grinder Motor-Driven, Type B

A heavy-duty, motor-driven, type B knife grinder has been placed on the market by Samuel C. Rogers & Co., 10-16 Lock St., Buffalo, N. Y. The machine is especially intended for grinding shear blades. It is made in ten sizes for handling knives up to from 54 to 130 in. in length, and 1½ in. thick. Motors of 3 hp., 25 or 60 cycle, can be supplied.

The machine has automatic feed for the knife and a center knife support. A spring cross-feed is provided, as well as an automatic stop. At the back of the machine is mounted a coolant tank with belt-driven coolant pump. The feed is operated from belt-driven reversing pulleys. The grinding wheel is carried at the front of the motor and mounted on its shaft. It is a 12-in. cup emery wheel. The tight and loose pulleys have a 3½-in. face and operate at 800 rev. per minute.

Similar to the full-automatic machine is the type C semi-automatic grinder. The latter has small handwheels at either end of the knife bar for feeding the knife up to the grinding wheel, whereas the feed of the type B machine is automatic.



"Rogers-Buffalo" Improved Knife Grinder, Motor-Driven, Type B

Trade Catalogs

Asbestos Materials. The Asbestos Shingle, Slate & Sheathing Co., Ambler, Pa., has published a booklet on Ambler asbestos lumber for the use of public utilities and electrical manufacturers. Among the products described is ebonized asbestos lumber, a material for use in controlboards and panels. The booklet contains data on the physical and electrical characteristics of various grades and thicknesses of asbestos lumber.

Ball Bearings. The New Departure Manufacturing Co., Bristol, Conn., has issued a circular featuring the use of New Departure ball bearings on racing cars. A view of the Atlantic City track and photographs of several drivers are given.

Brass, Copper and Bronze. U. T. Hungerford Brass & Copper Co., Lafayette, White & Franklin Sts., New York, N. Y. A sixty-four page catalog, 8x10¾ in., has been published by this company, listing the various sizes in which brass, copper and bronze stock can be had from the company as well as various products made from these materials. Many illustrations are included in the catalog to show examples of metal specialties and other products manufactured by the company. The list of products includes pipe fittings, roofing accessories, cornices and skylights, nails and tacks, screen cloth, hardware, rivets, washers, bolts and nuts, and other similar products made from these metals.

The catalog contains several pages of useful information in the form of tables giving weights of the stock, information on rivets, nails and tacks, and conversion tables. It is well prepared and bound in board covers.

Chucks, Air-Operated. The Logansport Machine Co., Logansport, Ind., has published its Catalog R-22 on "Logan" air-operated chucks. The bulletin contains forty-seven, 8½x11-in. pages arranged in a looseleaf folder.

The material included in the catalog

covers chucks and chucking equipment, air cylinders, valves, vises and work-ejecting air compressors.

Many illustrations and drawings of the various types of equipment are included with the text. Views are shown of several makes of production machines using "Logan" air-operated chucks or cylinders.

Cranes. Whiting Corporation, Harvey, Chicago, Ill. A folder recently issued by this company illustrates a number of material-handling devices and equipment for foundry and railroad shop service.

Cutters, Milling. Reed-Prentice Co., Worcester, Mass. A circular illustrates and briefly describes three types of Reed-Prentice milling cutters.

Engines, Gasoline. The Climax Engineering Co., Clinton, Iowa, has published its bulletins E, F, and G, on portable and stationary types of Climax gasoline power units, direct-connected electric generators, and direct-driven centrifugal pumps, respectively.

Each of the bulletins is 8½x11 in. and is designed for use in a looseleaf binder. They are attractively prepared and very complete in their descriptions of each factor to be encountered in the respective fields with which they deal. Graphs and tables are used in the descriptions to show the performances of the engines.

Engines, Oil. Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Direct-Injection Oil Engines for All Purposes," is the title of a booklet, containing thirty-two, 8½x11-in. pages, published by this company. The cover, which is in colors, illustrates applications of the engines to railway, marine, powerhouse, industrial and building service.

The description is devoted to the type "PO" engine and it is profusely illustrated with photographs of details of the machine and of many installations of this type of engine. The text is very full and gives information on the operation, fuel consumption, exhaust, advantages and construction of the engine. Drawings and diagrams are used to illustrate the function of the engine, and its specifications.

Furnaces, Electric. Ajax Electrothermic Corporation, Trenton, N. J. A folder describes and shows the use for the Ajax-Northrup high-frequency heating furnace of the induction type for making alloys free from carbon or other contamination and for studying the properties of matter at high temperatures under controllable chemical conditions.

Gears and Speed Reducers. Foote Bros. Gear & Machine Co., 215 North Curtis St., Chicago, Ill. This company's General Catalog No. 200 has been published. It is cloth bound and contains six hundred and twenty-two, 5x8-in. pages. The material included in the catalog covers spur, bevel, miter, worm, internal, helical, spiral, and herringbone gears, as well as racks, made from cast iron, steel, bronze, brass, rawhide, cloth, fiber and Bakelite. It also includes spur and worm gear speed reducers and special machinery.

The first section deals with speed-reducers, flexible couplings and bedplates. Their construction is illustrated by drawings and photographs and views are shown of many installations. The descriptions are quite full and clearly written. Many phases of speed reduction are discussed and a list of uses and applications is given. Drawings and tables show the specifications and sizes in which the reducers can be had from the company.

The section on gears sprockets, tractor transmissions, spline shafts and multiple key seats, illustrates the various types and contains complete specification tables.

The book contains also an engineering section of two hundred and four pages covering data and formulae, on spur gear speed reducers, conveying machinery, gearing, sprockets and chains, mathematical tables and formulae, weights and measures, composition of materials, heat-treatment, gages of threads and screws, mensuration, keys and keyways, taps and drills, power transmission, casting weights, electric motors and electrical equivalents.

The work is a very imposing one that is exceptionally well prepared. It will serve as a textbook and guide on gearing and its related problems, while the engineering section alone will make it a valuable contribution to trade literature.

Grinders, Lathes and Polishing Machinery. J. G. Blount Co., Everett, Mass. Catalog No. 22 published by this company covers its line of various types of grinding machines, combination grinding and buffing machines, tool grinders, ball bearing motor grinders, buffing machines, lathes and accessories. Each size is illustrated with a photograph of the machine and followed by a brief description and specification tables.

The catalog contains sixty-four 6x9-in. pages in which the typography is excellent.

Metals. Whiting Corporation, Harvey, Chicago, Ill., "Meehanite Metal" is the title of a circular which describes the chemical and physical properties of this metal which is said to be practically a pearlite iron. Microphotographs of various forms of iron are included in the circular.

Meters, Flow. The Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill., has issued a bulletin entitled, "Steam Economy." This booklet, Catalog No. S-33, contains fifty-six, 8½x11-in. pages, and is devoted to steam, water and gas meters, liquid level recorders and indicators, pyrometers, draft instruments, carbon-dioxide recorders, and coal meters.

The booklet is divided into three main sections which discuss steam economy, Republic installations in various industries, and the theory and construction of steam flow meters. The section on steam economy includes operation and management, the Republic system, flow meters in boiler operation, boiler room efficiency records, and power plant cost accounting.

The booklet is well prepared and is profusely illustrated with views of the instruments and charts as well as photographs of many installations of the equipment. It will be found of particular value to those concerned with the power plant.

Milling Machines. The Kempsmith Manufacturing Co., Milwaukee, Wis., has published the 1926 edition of its Catalog No. 50. The catalog contains two hundred and fifty-five, 4x6½-in. pages. Forty pages are devoted to sample estimate sheets of milling machine jobs and to photographs of many methods of setting up the various types of machines.

Many models are described and illustrated. The descriptions are, as a rule, confined to a single page and are concise in their preparation. Accessories, jigs, fixtures, gages and other products of the company are also included in the catalog.

A useful section containing information and data which will be found helpful is appended to the work. Suggestions in connection with milling machine operation are given as well as many other frequently needed tables.

Motors, Electric. The Master Electric Co., Linden and Master Aves., Dayton, Ohio, has issued a folder entitled, "Master Motors Make Good." The folder contains a description of the motor and its construction and several views of different types of the motors applied to equipment in various industries.

Sanitary Supplies. Century Brass Works, Inc., Belleville, Ill. Catalog M, containing thirty-two, 5½x7½-in., pages, describes many types of fixtures and supplies chiefly for industrial service, including fountains, sinks and coolers.

Starting Switches. Allen-Bradley Co., Milwaukee, Wis. Bulletin No. 710 describes and illustrates the type J-1552, Form T, across-the-line starting switch manufactured by the company. The description is full and each detail is thoroughly covered.

Turret Lathes. The Warner & Swasey Co., Cleveland, Ohio, has published Book III of its series on Modern Tooling Methods for Turret Lathes. This book is the second section on chuck work of the series and the material is largely drawn from the issues of the *American Machinist* for March and April.

The booklet covers typical chucking set-ups, reducing the tool cost, universal types of chucking tools, and answers to the question, "Will the increased production pay for the cost of the equipment, and also give a substantial profit on the investment?" Examples of work done and the tooling arrangements for the work are contained in the booklet. Descriptions show the uses of the various tools.

Forty-four, 6x9-in. pages are contained in this booklet which follows the distinctive design of the two previous ones. The set of three books makes a very useful reference series for turret lathe work and methods and it reflects the great amount of study and work that has gone into its preparation.

News of the Week

Executives Outline the Foreman's Position in the Scheme of Management

All branches of industry represented at annual meeting of national association in Springfield

An entire day of discussion of the problems of the foreman, taking up the relation of that executive to the administrative department and to production, and other personnel phases of industrial management, made up the program of the third annual meeting of the National Association of Foremen, held in Springfield, Ohio, on May 25. Nearly fifteen hundred foremen attended, representing practically every branch of industry. Many high executives also were present, and joined in the discussions, giving the opinions of their side to the problems presented.

President Thomas B. Fordham opened the meeting with a talk on "What is the Foreman's Job?" He began with a statement that the association was endeavoring to improve the position of the foreman in industry, to better both his condition and that of industry, to raise foremanship from being a "job" to the rank of a profession. He touched on the management's view of foremanship and of the workman's view—on training courses for foremen and on the teaching position of the foreman's job. The selection of foremen is still very haphazard and consequently discouraging to those who are earnestly striving to fit themselves for the work. There are, unfortunately, no standards as yet.

It is Mr. Fordham's belief that the one outstanding quality that managers look for and desire in foremen is the ability and the desire to assume responsibility. This, in his opinion, is the fundamental qualification of modern foremanship.

L. A. Hartley, director of education of the National Founders' Association then spoke on "The Foreman's Job as Seen by the Industrial Executive." He pointed out the difficulty in putting new ideas into practice owing to the inertia of the average mind. "There are," he said, "two kinds of foremen. One supervises and the other 'snoopervises.'" Much of the difficulty in shop management he attributes to misunderstandings on both sides.

Mr. Hartley generalized on the necessity of sound economics and warned against too much prosperity and contentment.

Dr. Harry Myers spoke of the "Foreman's Job as Seen by the Foreman." He brought out many of the foreman's difficulties, such as the effect of unequal demand on both quality and cost. Orders increase and he adds new men who must be trained, then the demand slackens and trained men must be laid off. This problem of seasonal or fluctuating demand, he believes, deserves the most careful attention from management and from those in charge of governmental agencies.

Costs should be more clearly explained in detail as to just what factors affect them. There must be a sympathetic employment manager who thoroughly understands the needs of the foremen in different departments.

Foremen need more examples of leadership from the management as the mood or shop atmosphere is usually handed down from the top. Unless the manager is a leader instead of a driver, all his talk about leadership is wasted. On the other hand too many foremen do not show an interest in learning about costs or other details. Some fail to keep their departments clean or to care for the equipment in them. This affects the ability to get new machinery as no manager is keen on installing new equipment under such conditions.

Dr. Myers suggested that every foreman ask himself what he should or could do, that he does not do. He advocated a foremen's club in every shop to study costs and methods.

"The Foreman's Job as Seen by the Workman" was the topic of Whiting Williams, who gave one of his interesting talks in his usual manner. One of the things that impresses a workman is the power that the foreman holds over his job—the ability to make it hard or easy or to throw him out of work at a moment's notice.

Talk of the superintendent's or manager's door being always open is misleading because no man dares go over the foreman's head. And foremen as he knew them, were no more interested in the company's welfare than were the laborers. Petty power, and the fact of being boss is what satisfies too many foremen.

Management does not always keep in touch with the training of foremen and frequently gives the best job to a hardboiled foreman, discouraging all who are trying to become foremen of the newer and better type. Men should be taught to think better of themselves, to respect themselves, to be able to give satisfaction out of the job.

After a lunch at Snyder Park there were inspection trips to the plants of Robbins & Myers, the International Harvester Co. and the Crowell Publishing Co.

New officers were installed as follows: T. B. Fordham, president; E. F. Myers, vice-president; E. H. Tingley, secretary, and W. Van Etten, treasurer. This was followed by a concert by Springfield's Civic Orchestra after which Charles L. Kettering talked on his knowledge of men and his own experiences. One of the first things he warned against was any attempt to put over bunk of any kind on the men—as it can't be done.

Foremen should study characteristics of men. All men will respond to the sympathetic point of view. Some of his suggestions were: "Ask yourself why you do things as you do and try and imagine what would happen if you tried another way. We are just beginning to think independently and are in a transitory stage with great possibilities ahead. Be open to outside suggestions. Satisfaction in the job is in knowing how to do it right. Prosperity is getting what you want, and comes from turning raw material into things we need and want."

The 1927 meeting will be held in Cincinnati.

Experimental Data on Quenching of Steels

In quenching steels from the customary hardening temperatures into such ordinary coolants as water, oil, or air, the experimental data given in a publication just released by the Bureau of Standards, Department of Commerce, show that a given size and shape cools in equal time to equal proportions of the cooling range. The data also show that the cooling time at the center of the sample minus a factor called "lag," for which a chart is included in the report, is inversely proportional to the surface per unit of volume raised to some power greater than 1 and less than 2.

The report includes a method whereby center cooling curves can be derived with a good degree of accuracy for various sizes of the simple shapes cooled in various media such as are ordinarily used in hardening steels.

Copies of this paper (Technologic Paper, No. 313) may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Russian Patents

Soviet Russia now grants patent protection for a term of 15 years to Russians and foreigners alike. It is required, however, that 5 years after application either production or licensing in Russia is established. The patent charges are due only when production has been brought about. The period of development without production may, however, on application be doubled.

Future of Industry in France Clouded by Uncertainty of Money Market

Customs duties and internal taxation have reached the limit of country's ability to pay—Railroads show improvement

BY OUR PARIS CORRESPONDENT

The uncertainty of general trade conditions was intensified by the falling franc of last month when from 29 francs to the dollar it fell to 30.50 francs before the end of April.

Foreign exchanges were further upset in the first days of the present month by the British strike situation when it was believed that London was selling francs to defend sterling in New York and Amsterdam.

Increase in customs dues of 30 per cent, as provided by the last finance bill, are affecting most imports, including those of raw materials for industry while the multiple turn-over tax and other new fiscal charges are proving already unexpectedly heavy burdens.

Increasing taxes on industry are heavier than it is believed possible to stand for. An electrical manufacturing plant in the Nord department states in its annual report that of its gross profits the government takes 60 per cent while the share holders get but 31 per cent, the remainder going to reserve.

It is encouraging in one way to note that railway receipts have increased monthly on the great trunk lines from 8 to 21 per cent over what they were a year ago. But these increased receipts are all absorbed by an increased wage scale and other charges brought about by the crisis through which France is passing.

GOLD CAPITAL NEEDED

French industry in many lines based on metallurgical products needs gold capital and gold credits for development, still more so for the establishment of new industries or equipping with machinery to supplant that labor which is not forthcoming. Private American loans or investment will do more for France as a whole than a government sought loan, as is proposed after the American debt settlement is ratified. Another hundred million dollar government loan will only add another thirty-two billion franc debt to that already being carried. If the French resolution to resist further inflation and settle foreign debts is confirmed the flow of capital from America to private borrowers should be great.

In spite of signs of progress it does not appear that new industries are making any great demand for machinery or tools. There is as yet nothing under way in France to compare to American activities with respect to the manufacture of household mechanical appliances or even small plant equipment. The popularizing of machinery in daily life has made no great inroads on older methods, hence little encouragement exists for establishing new ventures and America and Germany will doubtless go on supplying such items for long to come. Washing machines and refrigerating machinery, mechanical stokers for coal and oil fuel and multifarious electrical accessories are all but unknown so far as private possession and use are concerned.

There is some difficulty among machine and tool makers in getting supplies of semi-finished products — bolt makers are delayed in the filling of their orders for rods, building hardware and lock makers are in a somewhat like position as also the stamping works of the Ardennes for their basic material. The result will be depletion of stocks and still higher prices when it comes to filling orders for the future.

PRODUCTION AT CLOSE TO COST

Wire and wire nail makers have clapped on the expected rise of 10 francs per 100 kilos but trade therein seems to be normal. Screws and split pins and the like have been through the same mill, steel, iron and brass varieties having been advanced 12 to 40 per cent. Nut and bolt manufacturers are still working on back orders. The forged and welded chain makers are still in an equivocal position in spite of repeated efforts to unify classifications, price and distribution methods. The big makers do not complain but the smaller concerns, to get and hold business, are working close to production costs.

Copper and brass goods, above all plumbing accessories, are advancing prices continually, nothing is stable and demand fluctuates from a minimum need to that of speculative futures. Measuring articles in various metals are meeting the general price rise also, rules, callipers, etc., having been advanced 10 per cent. The boiler industry, above all in the north, is active but in general shipbuilding, outside the government arsenals, and repairing is at a low ebb.

The automobile industry has manifestly slumped within the country but exports are satisfactory. Imports of American cars have apparently fallen off, though the bulk in parts (which means doubtless knock-down cars) as per the French customs classification reached 6,091 metric tons.

Railway motive power orders have shown a revival. The P. L. M. railway ordered 104 units, largely from the Schneider works, with the Cail company in second place and Batignolles third. Electric motors and appliances are catching up with local demand but exports are continually increasing in bulk and value.

There is complaint that imports of agricultural machinery from Germany, on reparations account, are costing the user more than was anticipated when the accord was entered into by reason of the increase in the value of the mark by about 20 per cent. American import lines are accordingly less affected than was anticipated might be the case.

France is applying high protective measures, above all on behalf of her metal and machinery trades. Some clauses of the accord apply also in the form of concessions to imports from Poland, Czecho-Slovakia and Austria.

Machine tool hands, adjusters and fitters in the government arsenals are now being paid for the eight-hour day, with insurance and an ultimate pension as side issues, from 17.84 francs to 20 francs, with bonuses for families where there is one child or more. These figures are having their obvious effect on private industries which are more or less obliged to meet these same conditions if they are to hold their labor within the factory and avoid expensive turnovers.

Magnetic Testing of Steel to Be Reported to A. S. T. M.

A paper on the magnetic analysis of high-speed steel, giving the results of an investigation on the correlation between magnetic and electrical properties and the heat-treatment of a series of bars of high-speed steel, will be read by F. P. Fahy, chairman of the committee on magnetic analysis, at the first session of the twenty-ninth annual meeting of the American Society for Testing Materials, to be held June 21 to 25 at the Chalfonte-Haddon Hall at Atlantic City.

Haakon Styri will also read a paper on the magnetic testing of ball bearing races, describing a method developed to compare the magnetic qualities and hardness of ball bearing races by one reading. The first session, to be held Tuesday, June 22 at 2:00 p.m. will also hear reports on the testing of wrought and cast iron. The second session, at 8 p.m. will feature methods of testing.

Problems in connection with steel, to be discussed at the third session at 9:30 a.m. on Wednesday, will include an investigation of the effect of phosphorus and sulfur in steel, the effect of tin and arsenic on high-speed steel, the strength of welded joints, and others. At the same hour the fourth session will be devoted to brick, tile, refractories and fire tests. The first Edgar Marburg Lecture will be delivered by Arthur N. Talbot, professor in charge of Theoretical and Applied Mechanics, at the University of Illinois, at 4 p.m. on Wednesday.

The corrosion and fatigue of metals, will be the subject of the sixth session, meeting at 9:30 a.m. on Thursday simultaneously with the seventh session which will discuss road materials, waterproofing, petroleum products and thermometers. The eighth, ninth and tenth sessions will be held simultaneously at 8:00 p.m., and will be devoted, respectively, to non-ferrous metals and metallography; to textiles, rubber, coal, timber, insulating materials and slate; and to a symposium on rosin.

The eleventh and twelfth sessions will meet simultaneously at 9:30 a.m. on Friday, June 25, and will discuss, respectively, preservative coatings and naval stores; and cement, lime, gypsum and nomenclature. At 8:00 p.m. will be held the thirteenth and closing session, devoted to concrete.

Display of Inventions at Portland

The National Association of Inventors, having chapters and memberships in Washington, Oregon, California, British Columbia, and other states, will hold its second annual convention in the city of Portland, Oregon, June 17, 18 and 19, and in connection with the convention will stage an exposition of inventions.

The association was formed to promote common interests, co-operate with manufacturers, obtain publicity for inventors, improve patent laws, encourage inventions of merit, and in every way obtain recognition for inventors and by association enable them to do collectively what heretofore has been left to individual effort.

The exposition will afford inventors an opportunity to display and demonstrate their inventions before the public and will particularly attract the attention of manufacturers and promoters from all parts of the country. Inventors desiring displays are requested to prepare suitable models.

The Multnomah Hotel, Portland, Oregon, having 10,000 sq.ft. of display space and being centrally located, has been secured for this purpose. Special passenger and freight rates on all railroads have been secured, and all inventors who are interested and are desirous of exhibiting their inventions are requested to write to the association at Portland, making reservations for space.

German Rivet Makers Combine Interests

The German rivet market which is said in Germany to have been badly demoralized by heavy competition among various manufacturers is now being revived and strengthened through the combination of all important factories in the "Nietenverband" (Rivet Association), G.m.b.H., Duesseldorf. This Association has stated that it will try to stabilize the market in an effort to benefit the various member manufacturers and to enable them better to meet outside competition. A price-list already has been prepared by producers in the association.

Charcoal-Gas Motors Perfected in Sweden

A process for the operation of motor vehicles by charcoal fuel is claimed to have been perfected by a Swedish company, according to a report to the Department of Commerce.

The original generators of the fuel were designed for hardwood charcoal for which there is no general demand in Sweden. The most recently designed generators, however, have been fitted with a rotative purifier which is claimed by the company to remove the tar contained in coniferous wood charcoal and to make the gas fit for use as motor fuel.

The trial runs to demonstrate the utility of the invention are said to have given good results. A truck manufactured by the company has been run for a distance of 400 miles with a 2½-ton load and over indifferent country roads, at a cost of Kr. 8.50 for fuel. According to this and a number of similar comparative tests the fuel costs with charcoal are claimed to be considerably lower than with gasoline.

According to plans of the producers the gas generators will be adapted for tractors and later for motor trucks. The appliance, placed to the left of the driver's seat, does not require an excessive amount of space nor is it very expensive to fit.

Engineering Foundation Provides for Further Scientific Research

The quarterly meeting of the Engineering Foundation was held on May 19, members and guests gathering for dinner at the Union League Club, New York. Edward Dean Adams, John Fritz medalist for 1926, was the guest of honor.

Financial assistance was granted to two research projects requested by the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers. The sum of $4,000 a year for three years was granted for research in blast furnace slags by Professor R. S. McCaffery, of the University of Wisconsin. The sum of $5,000 a year for two years was granted for research in electrical insulation by Professor J. B. Whitehead, of Johns Hopkins University.

On behalf of the endowment committee W. L. Saunders announced that a contribution of $100,000 has been made to the foundation by Edward Dean Adams. In response to an appropriate resolution Mr. Adams was elected an honorary member for life in recognition of his service as vice-chairman of the Engineering Foundation for the past ten years.

Addresses were made by Dr. John A. Mathews, president of the Crucible Steel Co. of America, on "Present Tendencies in Engineering Materials," and by Professor Richard S. McCaffery on "Research in Iron Blast Furnace Slags." Dr. Mathews paid his respects to the present tendencies toward standardization in engineering materials through written specifications which are often practically useless. He deplored the necessity of "manufacturing down to a specification rather than up to an ideal." Unless specifications offer an advantage to both the maker and the buyer and contribute to public welfare they are often bars to progress. Dr. Mathews stated that metallurgy is rapidly becoming a branch of physical chemistry and cited alloy steels resistant to corrosion and high temperatures as examples of scientific efforts to meet engineering demands.

Professor McCaffery reviewed briefly the research in iron blast furnace slags in the University of Wisconsin and showed how their fundamental study of the constitution of slags was finding useful application in blast furnace operation. These studies will be continued under the support of the Engineering Foundation.

President Signs Aviation Bill

President Coolidge signed the Civilian Aviation bill on May 20. This bill establishes a Bureau of Commercial Aviation in the Department of Commerce and provides regulations for civilian fliers and for the operation of civilian air routes.

It is understood that Congress will be asked for an appropriation of $550,000 to carry on the work of the bureau. About $300,000 will be used for the development and maintenance of air routes and the remainder for administrative work.

Secretary Hoover expects important developments in civilian aviation as result of the new law. The new bureau will in no way conflict with the development of military aviation, but it is probable that there will be many situations in which there can be close cooperation in the development of air routes and landing fields which will aid in advancing aviation generally throughout the country.

Five Million Dollar Building Project By Westinghouse

The present building program for the expansion of facilities at various plants and offices of the Westinghouse Electric and Manufacturing Co., will involve an expenditure of $5,525,000, according to T. P. Gaylord, acting vice-president of the company.

New factory structures or office buildings are now in course of construction at East Pittsburgh, Pa., headquarters of the company, and at Mansfield, Ohio, Detroit, St. Louis, East Springfield, Mass., Sharon, Pa., and Derry, Pa.

The cost of the new general office building now nearing completion at the East Pittsburgh works of the Westinghouse Company is $1,500,000. The structure is 11 stories high. Plans for the construction of a $500,000 storehouse for finished products at the Mansfield works of the company have been approved. The building of steel-brick design will be four stories high. The building under construction in Detroit represents an expenditure of $400,000. The building is four stories, of concrete construction with brick exterior.

Plans have been completed for additional buildings at the East Springfield Works that will represent an outlay of approximately $475,000. The principal part of the program calls for a three-story office building. A four story extension to be built on the main factory will be of heavy mill-type construction.

Plans are being prepared for construction work that will entail a cost of $275,000 at Sharon, Pa. The program includes a five story building for light manufacturing purposes. The structure will be mill type of brick steel construction. A $75,000 office building is now under construction in Derry, Pa. The building will be two stories in height.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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EVERYONE knows what the word "normal" means but no one can precisely definne it. When applied to organic life it connotes health. Normal weather implies the usual succession of rain and sunshine without extreme temperatures or violent storms, and business in the United States at present may be properly described as normal because prices are neither high nor low and trade is showing the moderate increase that is to be expected in a growing country.

On the Stock Exchange the "Coolidge Boom" has been pretty well liquidated and the railroad stocks are commencing to move up again as earnings increase. In the commodity markets the fluctuations have registered the effect of seasonal developments or the operation of trade factors. There has been no "general trend" from which the existence of a common influence could be inferred and the only minor note that is to be heard as summer opens is the one sounded in Congress by those who are clamoring for some bill that will relieve the farmer.

In New York it is difficult to form an intelligent judgment of agricultural conditions in the West and South. Private advices insist that they are not as bad as the members of the farm bloc assert, but no one who reads the speeches printed in the *Congressional Record* can fail to be impressed by their gloom and the farmer vote is so important politically that it is almost certain that some way of placating it will be found before the national legislature adjourns.

For this reason and also because most of our agricultural staples are at or below the reputed cost of production it seems unlikely that they will go much lower. The law of supply and demand will probably be accelerated in its action by the possibility of governmental intervention and those who might otherwise procrastinate in buying are therefore less disposed to postpone their purchases.

To those who protest against what they call an interference with the operation of natural law this may seem undesirable, but it is a fact that the resiliency that the commodity markets have recently developed has toned up the whole body of business in this country.

The spirit of pessimism that was almost rampant four weeks ago has vanished and confidence has returned although enthusiasm is still lacking. The next stage would be a revival of speculation but there are no signs of its arrival as yet in spite of Judge Gary's optimistic speech and the advance in "Pigs and Pig Iron" that is cited by one alliterative financial writer as an evidence of returning prosperity.

In detail the week's developments need but little exposition. The gyrations of May wheat in Chicago have emphasized the strong position of the grain markets in general and short sellers are rather more diffident than they were. Cotton has been steady and hyper-sensitive to unfavorable crop news. Some condition reports that are construed to indicate a crop of under 14,000,000 bales have been issued.

Hogs and hog products as well as cattle are noticeably firmer. The sugar market seems to be adjusting itself to the action of the Cuban Government in curtailing the crop and the undertone has been appreciably better. The defence of coffee to which the Brazilian Government is committed has not yet been overcome and prices are well sustained.

Pig iron has been advanced and fabricated steel is somewhat higher, but the improvement is said to be due to a reduction of the output rather than an increase in the demand. Distributive trade throughout the country seems to be fully up to the average. Cotton goods in particular are somewhat firmer. The improvement is attributed to the policy of curtailment that some Southern mills have followed. Some irritation is expressed that this policy has not been more generally adopted and those mills that continue to run full time are being called slackers.

Leather and shoe manufacturers seem to be distinctly more cheerful, but those who sell straw hats are complaining about the backward spring. It is, however, an ill wind that blows nobody good. and the fruit and berry crops promise to be exceptionally good because by retarding their development the cold weather has put them beyond any danger of a freeze. It is estimated that the strawberry crop will be twice as large as last year's.

French francs have had a substantial recovery and as we write they are quoted at 3.19. The improvement, however, is chiefly sentimental as it appears to be based upon the hope that voluntary contributions from the French people will enable the government to stabilize the value of its currency. Such hopes have not in the past been realized and until the national legislature of France has the courage to face the situation and deal with it firmly sinking spells for the franc are to be expected.

The surrender of Abd-el Krim has however probably ended the Moroccan war in which France has been engaged and it ought to simplify the problem that confronts the French Administration.

But all these are but straws in the stream of the world's business. Upon the whole it appears to be flowing smoothly and while there is plenty of water there is no indication that it has reached or is near the flood stage that suggests the need of caution to the navigator.

What's Doing in Industry

No particular change was to be noted in the machinery and machine tool market in the past week. The month of May was apparently somewhat behind April in total volume of sales and the poorest month of the year for most manufacturers and dealers. However, recent industrial developments have brought out new lines of inquiry and June is expected to bring a substantial volume of orders.

Sales have dropped below normal in Cincinnati but railroad orders have served to brighten the outlook. In Indianapolis the volume of orders is only fair but much business is pending. Expansions in the automobile industry promise increased activity in Detroit.

Industrial conditions in Canada are on the upward trend and with many plants working to capacity, the buying of equipment has been stimulated. The New York market is slow and little new business has been placed. The South reports slight improvement, prosperous industrial conditions promising a good summer sales period. Business conditions in New England have continued to imorove and foreign trade is increasing in the general manufacturing industry.

Business in the United States may properly be described as "normal" because prices are neither high nor low and trade is showing the moderate increase that is to be expected in a growing country.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Southern District

Though Southern dealers report sales continuing to show a slight improvement from week to week, the total volume of business is still less than had been anticipated.

There is a good call for road building equipment and it has been improving steadily the past two or three weeks because of the favorable condition of the weather. For the same reason contractors are buying on a better basis, particularly in the immediate Atlanta territory where a large amount of construction is in progress. Sales elsewhere are less active, but are better in Florida than had been expected, building there being on a more stable basis since the decline of the real estate boom.

Garage and service station equipment is now moving on a fairly good basis, and the trade is looking for a particularly good volume during the summer months. Spring sales, however, were seriously affected by the long spell of cold weather retarding new garage construction, and generally lessening garage business so that operators of such stations were not in a mood to do much buying.

There is still a very good call for equipment from saw and planing mills, especially in the Florida territory, and for heavy woodworking machinery in the furniture manufacturing field in the Southeast. Indications are that this business will hold up through the summer.

Smaller machine shops are not buying much now, and what little they are taking is either used or rebuilt. The textile industry is improving slightly. There is a large amount of new textile mill construction in progress, and this should create a good market.

Railroad call is about on the same basis, but the inquiry is showing improvement, as there is considerable new shop and terminal construction in progress in the Southeast. Dealers believe this business may be equal to the excellent volume enjoyed last year.

Canada

Conditions in the metal-working industry in Canada are reported to be more satisfactory than at this time last year, with little in the outlook to belie the optimism expressed on all sides since the beginning of the year.

The steel-making portion of the Algoma Steel Corporation's plant is now working at capacity, and the company reports it has reason to believe that present orders will be augmented during the next few weeks. In addition to the rail business now being turned out, there has been a slight increase in the demand for automobile steel. The Tudhope-Anderson Co. of Orillia, Ontario, are experiencing the busiest season they have had for many years, the plow department, blacksmith shops and machine shops working fifteen hours a day. The National Hardware Co. also reports a busy season. Several new machines are being installed, and more men are to be employed. The Canadian General Electric Co. announces that during the first quarter of this year they booked orders considerably in excess of the first quarter of last year.

Indianapolis

Judging from the difference of opinion here, there is some spottiness in the machine tool and machinery business. Some users and buyers are working their plants steadily and are regular customers, while others have curtailed production and their demands are very light. On the whole, however, the total volume is about as good as could be expected in view of general conditions, and there is an optimism among leaders of the trade that augurs for a better summer than last year. The late spring has done much to curtail business.

Among the disappointing features of the market is the lax demand for special machinery from the furniture industry. Most factories report orders slow and their production much below normal. Demand for tools and special machinery from the fabricating plants in Indiana is good, particularly among those plants which manufacture structural steel and other items for the construction industry. Business is increasing as weather permits building.

Railroad business is somewhat slow and the volume is not looked for now that was had last year. Machinery demand from the coal fields continues good and this summer should show more volume than a year ago. The mines are working 70 per cent on an average, which is very good for this season.

Dealers in used machinery report a fair business, but the volume is only about the same as last year. However, demand is widely scattered showing that no one section of the country is being helped at the expense of another.

Cincinnati

Cincinnati machine tool manufacturers and selling agents report that the past week was very quiet from a sales standpoint. While there was a falling off in orders compared to the previous week, there is more than a grain of comfort in the fact that business was better than in the corresponding week of the previous year.

The decreased demand is regarded as merely a seasonal downward trend, and no great importance is attached to it. The number of inquiries received showed an increase in the week. Among the inquiries coming in were two fair-sized lists from railroads.

One manufacturer reports the receipt of an order from a tractor concern that is making extensions. The majority of orders booked in the week were for single tools, principally for replacement purposes, coming from general machinists and industrial users. A few orders came from automobile factories and some came from makers of trucks.

Factories are keeping their production at the point at which it has been for some time, and it is not thought that they will have to reduce their output. A large number of quotations have been made recently, it is pointed out, and if only a small percentage of these result in sales it will keep the market at a normal point.

The common feeling, based on general business conditions, is that the demand will not go below the present level.

New England

Small tool manufacturers — especially those in the New England territory—now feel that they are well into the cycle of business activity which seems to be defined in this trade. Some manufacturers are of the opinion that the surplus of small tools heavily produced for war purposes has been absorbed, basing this conclusion on the sources of recent buying. This is well scattered throughout the country.

Manufacturers of dies and chucks report a better market for their products and in this branch of the industry the opinion prevails that some of the buying is for stock. Foreign buying continues to expand and it is the measure of increase, especially from these sources, that leads to a conclusion that it is for more than immediate needs.

Orders placed for production machinery recently represent a well diversified distribution as to sizes and types. Some replacement buying by the railroads has been noticed, but in general this class of trade is quiet. A good volume of buying for the electric industry has been reported.

Detroit

Some increased activity has been found during the past few days in the machinery and machine tool market in Detroit and southeastern Michigan, but as yet there is nothing to indicate any material improvement in the slow market which has prevailed for more than a month.

The Chevrolet Motor Car Co. has announced that approximately six million dollars will be spent on new machinery. The Packard Motor Car Co. is making some additions to its line and is tooling up some of the departments which have not been up to the standard set some months ago. Much new equipment has been added in the experimental department where the aviation engines for the Government are being manufactured. The Ford Motor Co. has been laying off men during the past few days, and current rumors have it that a big change is contemplated in the Ford organization.

All the General Motors units are working full blast, and machinery representatives report a fair volume of business from them. This is largely small stuff, with some standard equipment, and some special.

Automobile production during April was 402,574 cars and trucks, the second largest monthly production in history.

Building construction is being maintained at record figures, and considerable construction machinery has been sold in the past few weeks.

New York

The closing days of May saw little of the new business that was expected to materialize. Inquiries held up to normal volume, but the percentage of quotations closed was small in comparison with the months immediately preceding. June offers more encouragement, and many believe that orders that were postponed will close now.

Buyers in the present market include all kinds of manufacturers. Contractors, and those who cater to the building trades, are busy and are taking up certain classes of equipment. Producers of electrical goods are also buying, though rather sparingly.

The larger industrials and railroads are making persistent inquiry for tools, but orders are being held up in the executive departments. General conditions in the stock market, the strength of the iron and steel business and other factors indicate a healthy trend, and machinery business is expected to pick up as soon as this knowledge becomes so certain that purchasers will go ahead with planned expansions. Machines ordered in the past week were mostly for replacement, little plant expansion being done now.

Trade Boom in Japan Delayed by Many Unfavorable Factors

Low demand for silk in America, decline of money market and disruption of steel industry all add to uncertainty of future

BY OUR TOKIO CORRESPONDENT

With every item of trade news being interpreted here as indicative that America will experience a marked curtailment of buying power before September, Japanese business is in the doldrums. Since the first of the year yen-dollar exchange has climbed from 43⅛ to 47¼. Cotton and silk prices have dropped accordingly. The Imperial Diet, in a session of unhappy mud-slinging, has succeeded in ruining the wheat flour export market by raising the wheat tariff.

Kabuto-cho, the Wall Street of Japan, is extremely pessimistic, fearing that slackening demand for Japanese silk, in addition to other unfavorable factors, will postpone the Empire's long-expected boom for another 18 months. Dealings on the Tokyo Stock Exchange have fallen to a ninth of their highest December volume.

Preparations on the part of India to adopt a gold standard and wars in China have lowered the bar silver rate, affecting Japan's exports to both countries.

New York demand for silk is falling off, bringing the lowest prices in years for the best grades, which now are hovering around $6 per pound. As Japan's prosperity depends upon the American market for her silk, this development is occasioning no little worry on this side.

Prices for smoked sheets are off in the rubber markets of the world and confidence in the future of Japanese plantation companies is waning. Their securities have made marked recessions on the Tokyo Stock Exchange.

On the other side of the ledger is the improvement in the nation's foreign trade position and the fact that the prolonged depression is actually strengthening the fabric of Japanese business. Japan, handicapped by the 1923 earthquake and many other factors, has been unable to emerge from the depression which followed the panic of 1920. As a result, only the strongest and most trustworthy firms have been able to survive. There have been amalgamations without number, combinations for co-operative buying and selling and many other arrangements which, in toto, have greatly strengthened and unified the business of the Empire.

Falling ocean freights and heavy buying at the turn of the year in the expectation that permanent reconstruction would be large have thrown the lumber market into chaos. Demand for American lumber will probably be slack until September.

Steel manufacturing is at low ebb, handicapped by shortage of ore and pig iron from Manchuria. Government authorities are greatly concerned over the absolute breakdown of the Hanyehping Colliery and Iron Co., which was under contract to supply 300,000 tons of ore and 100,000 tons of pig iron annually to the government steel works at Edamitsu. The government and the Industrial Bank of Japan in past years have advanced Yen 50,000,000 to this Chinese plant, which is under Sino-Japanese control. Last year, when the plant was in financial straits, the government loaned Yen 8,500,000 more through the Yokohama Specie Bank. It now appears that the Chinese faction among the managers misappropriated this loan, divided it among themselves and used it to finance China's innumerable wars. So far in 1926 not a single ton of ore or pig iron has been shipped from the works to Japan. As a matter of fact, laborers' wages are said to be in arrears, only two locomotives capable of pulling ore trains are left on the property, its private right of way is in almost hopeless condition and marauding armies have removed almost everything of value. Under present conditions it is considered highly unlikely that Japan will advance more money. If she does not, she must write off her loss and look elsewhere for raw materials.

On April 11 the government placed the Steel Manufacturing Industry Encouragement Law in effect. This act contains carefully graded subsidies and exemptions covering practically the entire industry. It provides that any plant equipped to produce over 35,000 tons of pig iron and 35,000 tons of steel a year in one place is entitled to exemption from the business tax for 15 years. Crucible or electro-steel manufacturers producing over 3,500 tons a year are similarly exempted.

Machinery and raw materials for firms benefiting by the act shall be exempted from import tariffs for 15 years.

Only three plants are at present equipped to produce both pig iron and steel to the extent of 35,000 tons of each annually. These are given additional subsidies of Yen 6 per ton. They are the Kamaishi Steel Works, the Wanishi Steel Works of the Japan Steel Manufacturing Co., and the Kenjiho Works of the Mitsubishi Mining Co.

Management Week Will Review Waste Problem

"Progress in Waste Elimination" will be the theme for Management Week, which will be held this year during the week of October 25.

Progress is to be shown by a review, or an audit of results accomplished, savings made, and benefits gained from the nation-wire effort, during the past five years, to eliminate waste in production and distribution. The sponsor organizations are: American Society of Mechanical Engineers, American Management Association, American Institute of Accountants, Taylor Society, Society of Industrial Engineers, and the Division of Simplified Practice of the Department of Commerce.

The plan of organization is for local members of each sponsor association, each co-operating organization, and each group interested in better management to join forces in forming a Local Management Week Committee, elect their own chairman, develop their own program, and "run their own show." In this way, the national committee believes, "Management Week, 1926," will prove a most important and successful event.

The committee has asked Joseph W. Roe, of New York University to organize the first meeting of local interests.

Report Ready on Rivet Standardization

The report of the sectional committee on the Standardization of Bolt, Nut and Rivet Proportions, working under the procedure of the American Engineering Standards Committee, has finished its preliminary work and the tentative standards have been submitted for approval. The sectional committee was organized in 1922 by the Society of Automotive Engineers and the American Society of Mechanical Engineers.

The standard types of small rivets (½ in. and under) covered by this report are designated as flat head, countersunk head, round or button head, pan head and truss or wagon-box head. All other rivets within the limits of diameters given are to be considered special. Copies of this report may be had from the committee and criticisms are invited. C. B. LePage, assistant secretary of the A.S.M.E., 29 West 39th St., New York, is in charge of this work.

The Breguet company (Societe Anonyme des Ateliersd'Aviation Louis Breguet) is said to be the largest producer of airplanes in France. Its factory and flying field adjoin those of the Service Technique Aeronautique of the French government. It employs about 2,300 workers, many of whom are women.

What the Railroads Are Doing

The American Locomotive Co. has received orders from the Union Pacific Ry. for fourteen 248-ton, three-cylinder locomotives and from the Northern Pacific for twelve 215-ton Mountain type locomotives. The Southern Pacific has ordered one snow plow from the same builder.

The Boston & Maine has placed an order with the Clark Car Co. for six air dump cars. A contract for two air dump cars has been placed with the Case Crane and Engineering Co. by the Hocking Valley.

Inquiries in the market include 100 hoppers, 100 gondolas, 50 stock and 25 flat cars from the Tennessee Central and 800 mine cars from the Pennsylvania Terminal Coal Co. It is expected in equipment circles that the Central Railroad of New Jersey will distribute contracts soon for from 800 to 1,000 box cars and 200 automobile cars.

Efforts of railroads to increase operating efficiency and add to returns by use of more powerful motive power, larger cars and longer trains are shown by comparing present figures of the Pennsylvania Railroad System with those as recent as 10 years

ago. The Pennsylvania is said to have the largest railroad shops in the world, at Altoona, Pa., and its motive power engineers are constantly experimenting and developing new types of locomotives or refinements which will add to the tractive power of locomotives. At the same time, capacity of freight cars has been increased and steel rails made heavier and improved to stand the added strain.

Announcement has been made that construction has been authorized by the Chicago & Eastern Illinois R.R, for an additional roundhouse at Evansville, the structure to cost $500,000. Construction will be started soon. The structure will be of brick and steel and will be equipped with the latest machinery. As soon as it is in operation the shops will increase the number of employees there.

The Atlantic Coast Line Ry. has announced that Tampa, Fla., had been selected as the site for the large locomotive works and machine shops the company plans to construct. Work on the project will begin immediately. An investment of approximately $2,500,000 is contemplated, of which about $1,000,000 will be for machinery and equipment. When the locomotive repair works are fully completed an investment of about $5,000,000 will have been made by the company in this project alone.

Personals

R. C. FELTES has been appointed district manager of the Chicago office of the Hisey-Wolf Machine Co., of Cincinnati.

C. H. CARLISLE has been elected president of the Goodyear Tire and Rubber Co. of Canada, Ltd.

H. J. GROSVENOR, vice-president of the S. F. Bowser Co., has been elected to the board of directors.

J. S. HARTWELL has been appointed consulting engineer for the Kelly Reamer Co., Cleveland, Ohio.

H. S. CLAY, of the Oliver Chilled Plow Works, South Bend, Ind., recently was named vice-president of the South Bend Purchasing Agents' Association.

G. K. CONANT, of St. Louis, was elected president of the American Iron, Steel & Heavy Hardware Association at its convention held last week at Atlantic City.

C. W. GOODRICH resigned from the U. S. Corps of Engineers to become chief engineer for R. A. Jones & Co, Cincinnati, Ohio.

LOUIS L. GREENWALD, formerly with the De Laval Separator Co., has been appointed sales engineer for the Chicago Pump Co., Chicago, Ill.

F. F. HARTER has been appointed branch manager of the Philadelphia office of the Crucible Steel Co. of America, with headquarters at 1224 Callowhill St.

CARL L. HOLBROCK, district manager in Milwaukee for the S. F. Bowser Co., has been appointed industrial sales promotion manager of the company.

EDWARD T. ELBOURNE, London, consultant on factory organization and cost systems, will arrive in New York on June 17, to pay a visit which will extend over six months, to investigate industrial management methods.

L. G. HOWLETT, factory manager and engineer for the Club Aluminum Co., of Chicago, is now in charge of the company's factory in Baltimore. Paul Richter, formerly with the Industrial Works at Bay City, Mich., has succeeded Mr. Howlett in Chicago.

L. W. ROLFE has been appointed sales manager for the Taylor Electric Truck Co., of Troy, N. Y., manufacturer of electric railway car trucks, springs and similar equipment. Mr. Rolfe was formerly associated with the Simmonds Machine Co., of Albany.

R. F. SHAW, sales representative in Grand Rapids for the Kearney & Trecker Corporation, of Milwaukee, has been transferred t othe Chicago office. Mr. Shaw will continue to have charge of the western Michigan territory, and in addition a portion of the Chicago and northern Illinois district.

Obituaries

THOMAS D. PICKARD, 70 years old, for years an executive in the Brass Foundry and Machine Co., Fort Wayne, Ind., died recently in Chicago.

CHARLES MATTHEWS, president of the Matthews Gas Machine Co., died in Chicago on May 19. He was a native of Germany, and came to the United States in the late fifties. He was 86 years old.

HORACE G. HOADLEY, president and treasurer of the Waterbury Tool Co., of Waterbury, Conn., died at his home in Belmont, Conn., on May 23. He was a member of the American Academy of Political and Social Science and of the American Management Association.

PAUL B. HUSTON, advertising manager of the Cleveland Automatic Machine Co., of Cleveland, died suddenly on May 24. Mr. Huston was stricken while driving in his car to the office and died before medical aid could be obtained. He had been associated with the Cleveland company for the past twenty-five years, as chief cost accountant and later as advertising manager.

Business Items

The C. H. Wood Co., of Syracuse, N. Y., is celebrating its twenty-fifth anniversary in business.

The Railway Steel Spring Co. has been incorporated in Delaware to manufacture railway springs, tires and similar equipment. A. S. Henry, of 30 Church St., New York, is president.

The Manhattan Brass Co., of New York, has retired from business. The plant and equipment will be sold at auction on June 10 and 11 through the Industrial Plants Corporation, of 25 Church St., New York.

The Carr Fastener Co., of Cambridge, Mass., has disposed of its interests in the automotive field, and will concentrate on the development of the "Dot" lubricator for industrial uses.

The Bridgeport Brass Co., Bridgeport, Conn., has enlarged the territory of H. Allen Faust, 915 City Center Building, Philadelphia, Pa., who has been salesman for the company in Pennsylvania and New Jersey, to include Maryland, West Virginia and Washington, D. C.

The Ferguson Allen Co., of Buffalo, N. Y., engineers and boiler makers, has purchased the plant of the Batavia Car Works, Batavia, N. Y., which it has been occupying under lease for the last two years. Some improvements will be made. Ferguson-Allen specialize in locomotive repairing.

Manning, Maxwell & Moore, Inc., of New York, announce the removal of their general accounting and clerical forces to Bridgeport, Conn. The railway and mill supply departments have moved their clerical and service forces to the warehouse in Jersey City. The executive and sales offices will be maintained as heretofore at the general offices of the company which will be continued in the Pershing Square Bldg., 100 East Forty-second St., New York. This change has been made to unify those departments having to do with the company's manufacturing plants.

Forthcoming Meetings

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 39th St., New York City.

Iron and Steel Exposition. Annual exhibit of fuel, electricity, machinery and safety under the auspices of the American Society for Steel Treating, Hotel Sherman, Chicago, June 7, 8, 9 and 10. Secretary, Mr. Kelly, Empire Bldg., Pittsburgh, Pa.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

National Association of Cost Accountants. Seventh annual international cost conference, Ambassador Hotel, Atlantic City, N. J., June 14, 15, 16 and 17. S. C. McLeod, secretary, 130 West 42nd St., New York.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual production meeting, Hotel Sherman, Chicago, Sept. 21, 22 and 23. John Warner, manager of meetings department, 29 West 39th St., New York.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under Association. R. E. Kennedy, secretary, 909 the auspices of the American Foundrymen's W. California St., Urbana, Ill.

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

The Weekly Price Guide

Rise and Fall of the Market

THERE is fairly active demand in the current market for steel pipe, bars, wire products other than nails, plates, bolts, nuts, and rivets. Other items on the steel list are moving slowly. Iron prices appear to be settling at present levels with buying inactive. Steel shapes and plates range from $1.80 to $1.90 per 100 lb. at mills, while bars sell at a minimum of $1.90 per 100 lb., Pittsburgh. The $2 figure recently quoted on bars is disappearing from the market. Copper prices hold at May 21 levels; other non-ferrous metals are slightly under. Scrap copper (light) and lead declined during the week at Chicago; old zinc and light brass, in New York. The recent steady downward course in antimony prices may have reached its lowest point for the season, since June proved to be the turning point in this metal, each year since 1922.

(All prices as of May 28)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	28.67
Basic	22.26
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.27
Basic	21.27
Bessemer	21.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.25	3.50
No. 12	2.45@2.55	3.94	3.30	3.55
No. 14	2.50@2.60	3.99	3.35	3.60
No. 16	2.60@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.65	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.75	4.35	4.35
No. 16	3.75@3.85	4.90	4.50	4.50
Nos. 18 to 20	3.90@4.00	5.05	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.20	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.35	5.10	4.95
No. 28	4.50@4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches ¼	⅜	½	⅝	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 1/16@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15 12½
Tin, 5-ton lots, New York			62.75
Lead (up to carlots) E. St. Louis	7.50	New York	8.35
Zinc (up to carlots) E. St. Louis	6.85	New York	7.75

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	11.75	16.50	12.50
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	38.50	42.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	76.00
Commercial genuine, intermediate grade	55.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	13.62½

Nickel, f.o.b. refinery, cents per lb.:
Ingots..... 31.00 Electrolytic.. 38.00 Shot.....32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75@12.25	11.25	10.75@11.25
Copper, heavy, and wire	11.00@11.50	11.50	10.25@10.75
Copper, light, and bottoms	9.50@ 9.75	9.75	9.25@ 9.75
Heavy lead	6.75@ 7.00	6.50	6.00@ 6.50
Tea lead	4.50@ 4.75	5.00	5.00@ 5.50
Brass, heavy, yellow	7.00@ 7.25	7.25	7.00@ 7.50
Brass, heavy, red	9.25@ 9.75	9.50	8.25@ 8.75
Brass, light	5.75@ 6.00	6.00	6.25@ 6.75
No. 1 yellow rod turnings	8.25@ 8.50	8.00	7.50@ 8.00
Zinc	4.25@ 4.75	4.00	4.00@ 4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.45	$11.50
"A" Grade:				
IC,	14x20	9.70	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.17	.12@.17
Wiping cloths, washed white, per lb	.18	36.00 per M	16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	3.60†	3.35	4.25‡
Linseed oil, per gal., 5 bbl. lots	.84	.98	.87
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1662½	.1662½	.1587½
Solder (½ and ½)	per lb.	.385	.4012½	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	35	35	.35
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		2.85@ 3.00
Coke, prompt foundry, Connellsville	per net ton		4.00@ 4.50
White lead, dry or in oil	100 lb. kegs		New York, 15.25
Red lead, dry	100 lb. kegs		New York, 15.25
Red lead, in oil	100 lb. kegs		New York, 16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ill., Lansing—Ford Motor Co., Highland Park, Mich.—equipment for shop for proposed 1 story, 124x125 ft. airplane hangar here.

Ind., Indianapolis—Bd. of School Commissioners, W. M. Frazer, Bus. Dir., will receive bids until June 5 for 6 engine lathes, 1 milling machine, forges, etc., for Washington High School, also 1 engine lathe for Thomas Jeffersno High School.

Mass., Cambridge (Boston P. O.)—F. W. Dixon, 1-3 Dock St.—quick change gear lathe, 16 in., 10 ft. bed, compound rest.

Mass., Dorchester (Boston P. O.)—H. B. Barrow, 36 Abbot St.—tools and equipment for proposed 2 story repair and service garage. Estimated cost $100,000.

Mass., Medford (Boston P. O.)—G. Ulett, 23 Wedgemere Rd.—screw cutting engine lathe, medium size.

Mass., South Boston (Boston P. O.)—Garstein Bros. & Cooper, 1-3 West Third St. (boilers)—machinery and equipment for proposed 2 story, 60x100 ft. factory.

N. J., Jersey City—General Purchasing Agent, Hudson County, will receive bids until June 14 for machinery, tools, etc. for county police garage.

N. J., Jersey City—A. Spindler, 243 Mercer St.—moniter lathe, 18 in. swing.

N. J., Newark—Kreuter & Co., Inc., 585 18th Ave.—four 15 in. engine lathes.

N. Y., Brooklyn — Mutual Electric & Hardware Mfg. Co., 28 Veranda Pl.—1 in. Ajax upsetting machine, power press, Universal milling machine, large planer and shaper.

O., Lima—Ohio Iron & Supply Co., 909 St. Johns Ave.—one 2 to 10 in. and one 1 to 4 in. pipe machines.

O., Marietta—P. I. Spence, 315 Gilman Ave.—crank shaft grinder for machine shop.

Pa., Bristol—Pacific Steel Boiler Corp.—84 in. light duty boring mill.

Wis., Janesville — Fisher Body Corp., Durant Bldg., Detroit, Mich.—body building machinery for proposed 1 story, 150 x 645 ft. factory, here. Estimated cost $200,000.

Que., Jonquiere — L. Parent — grinder, press, etc. for machine shop.

Opportunities for Future Business

Calif., Emeryville—Kirsch Mfg. Co., 4514 Hollis St., Oakland, manufacturers of flat metal curtain rods, plans the construction of factory at 45th and Holden Sts., here.

Calif., Oakland — Black & Decker Mfg. Co., 75 Fremont St., San Francisco, manufacturers of electric shop tools and equipment, awarded contract for the construction of a 1 story factory on East 10th St. $36,577. Noted May 27.

Calif., San Francisco—American Radiator Co., 2nd and Townsend Sts., awarded contract for the construction of a 2 story factory and office at Fourth and Townsend Sts. $70,000.

Calif., San Francisco—Cosmopolitan Machine Works, 57 Tehama St., awarded contract for the construction of a 1 story, 55x88 ft. machine shop at Hampton and Folsom Sts.

Calif., Santa Rosa—Cover-Lewis Motor Co., First and Main Sts., awarded contract for the construction of a 1 story garage and showroom on B St. $150,000.

Conn., Hartford—F. W. Arnold & W. H. Van Sant, 776 Framington Ave., West Hartford, plans the construction of a 6 story garage at Hicks and South Ann Sts., here. Estimated cost $600,000 to $700,000.

Ind., Kokomo—Kokomo Steel & Wire Co., J. E. Frederick, Gen. Mgr., plans to rebuild part of plant including nail mill, shops, etc., recently destroyed by fire. Loss is estimated at $250,000.

La., New Orleans—American Steet Metal Works, Inc., G. Koehler, Secy. and Treas., 3500 South Carrolton St., will soon receive bids for the construction of a 1 story plant at Alexandria and Conti Sts. Favrot & Livaudais, Hibernia Bank Bldg., Archts. Noted May 13.

Md., Baltimore—Wilson Nash Motors Co., T. W. Wilson, Jr., Pres., 1109 Cathedral St., awarded contract for the construction of a 1 story, 90x195 ft. service and sales building at 29th St. and Remington Ave. Estimated cost $65,000. Noted Apr. 22.

Md., Baltimore—Zell Motor Car Co., Mt. Royal Ave., is having plans prepared for the construction of a 2 story, 140x230 ft. service station and showroom at 29th St. and Remington Ave. Estimated cost $100,000. T. W. Pietsch, American Bldg., Archt.

Mass., Boston—F. B. Curry, 72 East Dedham St., will build a 3 story, 40x65 ft. addition to shop. Estimated cost $50,000. Private plans.

Mass., Boston — Noyes-Buick Co., 857 Commonwealth Ave., is having preliminary plans prepared for the construction of a 2 story garage and service station on North Beacon St. Estimated cost $175,000. F. A. McSheffrey, 857 Commonwealth Ave., Archt.

Mass., Jamaica Plain (Boston P. O.)—Buff & Buff Mfg. Co., Green St., manufacturers of surveying instruments, is having plans prepared for the construction of a 1 and 2 story addition to factory. Estimated cost $40,000. R. B. Wills, 8 Beacon St., Boston, Archt.

Mass., Jamaica Plain (Boston P. O.)—M. Doyle Co., 44 Perkins St., awarded contract for the construction of a 1 story, 65x75 ft. repair and service garage on Centre St. Estimated cost $40,000. A. F. Brodin, 10 Hadwain St., Rosindale, Archt.

Mass., Melrose (Boston P. O.)—Eastern Mass. Street Railway Co., 5 Fernwood St., Revere, awarded contract for the construction of a 1 story, 100x225 ft. car house and repair shop here. Estimated cost $50,000.

Mass., Somerville (Boston P. O.)—C. E. Hall & Sons Co., 60 Cross St., awarded contract for the construction of a 1 story, 90x135 ft. repair and service garage. Estimated cost $50,000.

Mass., Springfield—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., will build 3 additional buildings to manufacturing plant at East Springfield, Mass. Estimated cost $1,000,000. B. H. Frack, Martin Bldg., Pittsburgh, Pa., Archt. and Engr.

Mass., Worcester—O. Neiber, 157 Lovell St., is having plans prepared for the construction of a 1 story repair and service garage. Estimated cost $40,000. H. L. Meacham, 120 Front St., Archt.

Mich., Detroit—A. Kahn, 1000 Marquette Bldg., Archt., is receiving bids for the construction of a 4 story shop and office building on Trumbull Ave. for Westinghouse Electric & Mfg. Co., 4584 Maybury Grand. Estimated cost $400,000.

Minn., St. Paul—Dept. of Administration and Finance, Capitol, St. Paul, awarded contract for the construction of maintenance shops at Detroit, Brainerd and Bemidji and Rochester for State Highway Dept. Estimated cost $19,615, $19,225, $18,990, and $19,336 respectively. Noted May 27.

Mo., Kansas City—Woods Bros. Construction Co., Security Bldg., plans the construction of a 1 and 2 story, 90 x 125 ft. factory on Woodsweather Ave. Estimated cost $40,000. Private plans. Field Hardware Mfg. Co., 111 East 31st St., lessee.

Mo., St. Louis—Oliver Cadillac Co., 3222 Locust St., is having preliminary plans prepared for the construction of a 2 story sales and service station on Lindell St. Estimated cost $250,000. Mauran, Russell & Crowell, Chemical Bldg., Archts.

Mo., St. Louis—Seven-Wal Garage Co., c/o W. King, Pres., 500 Walnut St., awarded contract for the construction of a 6 story, 160x215 ft. garage at Seventh and Walnut Sts. Estimated cost $275,000,

Neb., Omaha—Metropolitan Utilities Dist., received low bids for the construction of a 3 story, 139 x 172 ft. garage and service station at 20th and Center Sts. Estimated cost $275,000. John Latenser & Sons, Peters Trust Bldg., Archt. Noted May 20.

N. J., Camden—American Brown Boveri Electric Co., Broadway and Fairview St., plans the construction of a 1 story, 60 x 180 ft. addition to plant. Private plans.

N. J., Flemington — Universal Joint Co., Plainfield, awarded contract for the construction of a 1 story, 60 x 100 ft. plant, here. $60,000. Noted Dec. 31, 1925.

N. J., Newark — R. J. Wing Mfg. Co., Victoria St., manufacturers of fans, blowers, etc., is having plans prepared for the construction of a 1 story addition to plant on Frelinghuysen Ave. Estimated cost $45,000. Fletcher-Thompson, 350 Madison Ave., New York, N. Y., Archt. and Engr.

O., Cleveland—Barnes Motor Co., (Dodge Bros. Agency) W. P. Barnes, 1938 East 21st St., plans the construction of a 1 and 2 story auto sales and service building at 2830 Prospect Ave. Estimated cost $150,000. C. S. Schneider, 1836 Euclid Ave., Archt. Noted May 6.

O., Cleveland—Northern Blower Co., L. Elben, 6409 Barberton Ave., had plans prepared for the construction of a 1 story, 45x115 ft. addition to factory. Estimated cost $40,000. C. H. White, 1238 East 80th St., Archt.

Pa., Fox Chase (Philadelphia P. O.)—John J. Nesbitt, Inc., c/o Ballinger Co., 12th and Chestnut Sts., Philadelphia, manufacturers of ventilators, awarded contract for the construction of a 1 and 2 story, 182 x 193 ft. plant at Rahn St. and State Rd., here. Noted May 20.

Pa., New Castle—National Radiator Co., Johnstown, awarded contract for the construction of a 1 story addition to plant here. Estimated cost $100,000.

Pa., Philadelphia—Edward G. Budd Mfg. Co., manufacturers steel auto bodies, awarded contract for the construction of a 1 story, 72 x 143 ft. press shop at 25th St. and Hunting Park Ave.

Pa., Sharon — Westinghouse Electric & Mfg. Co., Walnut and 30th Sts., Philadelphia, is having plans prepared for the construction of a 5 story, 70 x 220 ft. addition to plant here. Estimated cost $275,000. Noted May 20.

R. I., Providence—New York, New Haven & Hartford R.R. Co., plans the construction of a 1 story repair shop and service garage. Estimated cost $40,000. E. Gagel, New Haven, Conn., Ch. Engr.

Wis., Jefferson—Jung & Reul, awarded contract for the construction of a 1 story, 50x100 ft. repair shop and service station. Estimated cost $40,000.

Wis., Platteville—F. Russell, will build a 1 story, 42x110 ft. machine shop and 20x30 ft. garage. Estimated cost $30,000. H. Kleinhammer, Archt. Noted Apr. 8.